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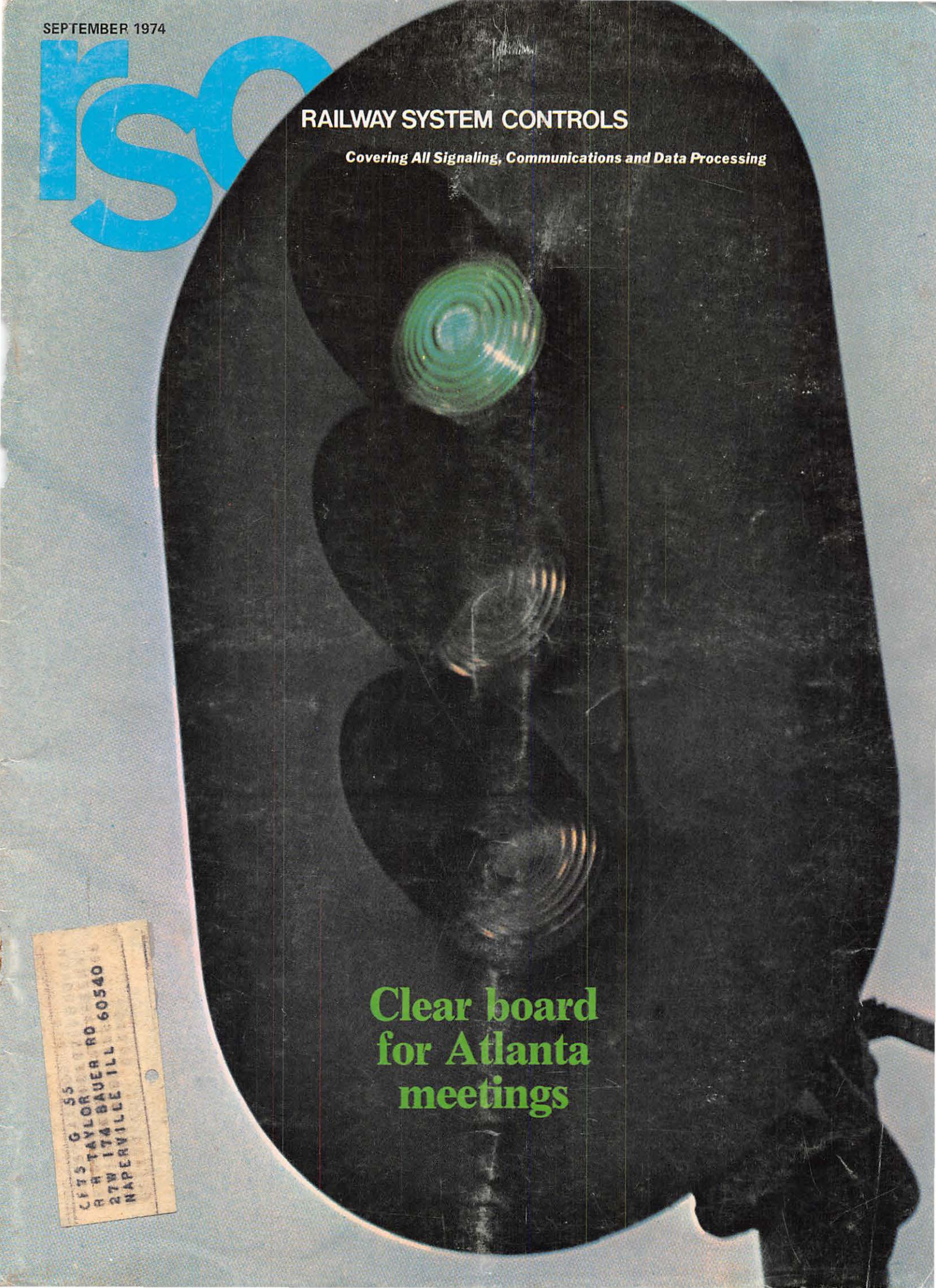

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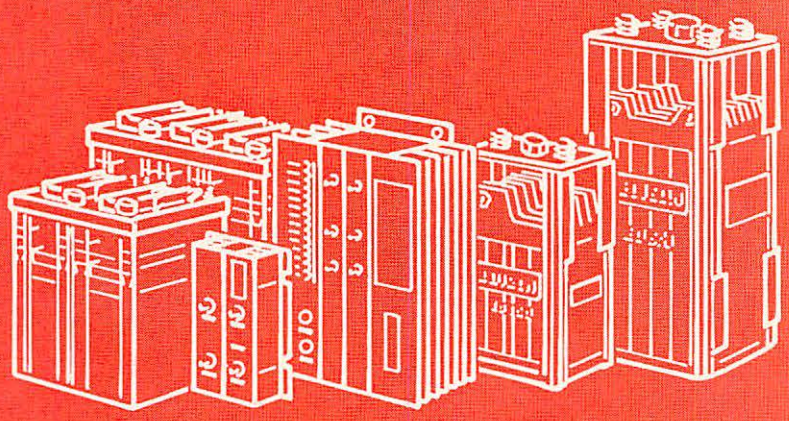

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SEPTEMBER 1974 VOL. 5 NO. 8

RSC RAILWAY SYSTEM CONTROLS

(Formerly Railway Signaling & Communications)

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RSC News

Chessie's 'yet to be built' $6.1 million microwave network will have 45 stations with a total of 1,346 voice channel ends to provide connections for the 850-route-mile system.

Chessie to link 45 stations with microwave network

Chessie System has signed a $6.1 million contract with the Collins Radio Co. of Dallas, Tex., for the construction of a microwave network on the lines of the Chesapeake & Ohio and Baltimore & Ohio.

The communications system will connect the cities of Baltimore, Pittsburgh, Detroit, Cincinnati, Willard (Ohio), Huntington (W.Va.), and 10 intermediate cities. Forty five stations with a total of 1,346 voice channel ends (expandable to 4,800 channel ends) will provide connections for the 850-route-mile system.

John T. Collinson, vice-president in charge of operations for the Chessie System, says "The microwave system will provide us with a high quality, highly reliable voice and data connection network that will fulfill present requirements. The system will be designed to allow for economical expansion as our communication requirements change." He pointed out that the microwave system would save Chessie over $1 million annually in communication costs.

Breakdown of the system includes 11 terminals, 25 repeaters, 9 three-way junctions, and 5 passive repeaters making up the RF portion of the installation. All of the equipment is Collins MW-328 solid state microwave configured with hot standby transmitters and space diversity receivers. The system operates in the 6 GHz operational-fixed band.

The system is designed for 600 channel operation within the 10,000 F9 emission designator as required by the FCC. The 600 channel operation requires a perchannel deviation of 140 KHz. The minimum per hop performance will be 51 dB NPR.

Work on the microwave network is expected to begin this fall with completion scheduled for late summer of 1976.

Under terms of the turnkey contract, Collins will design, manufacture and install all equipment, construct sites and buildings, and perform complete system checkout. Battery chargers and batteries with an eight-hour operating reserve will be located in each station to protect against power failures. Duplicate chargers will be included so that failure of one charger will not interrupt system operations.

The microwave system will require the construction of prefabricated buildings at 33 locations to house the equipment. Collins will supply fiberglass buildings, manufactured by Virginia Fiberglass, Inc. The towers supporting the microwave antennas will be constructed of steel to withstand all kinds of weather in the various geographical areas covered by the system.

AAR survey shows 256 computers in RR use

The Association of American Railroads' annual computer survey has now been completed. The survey shows that as of June 1, 256 computers were being used by 79 railroads in the U.S. and Canada, by rate associations, and by the AAR itself. Biggest users are Canadian National (23), Penn Central and Southern Pacific (17 each), Chessie System (16), Sante Fe and Burlington Northern (12 each), Union Pacific and Canadian Pacific (10 each), Milwaukee Road, Kansas City Southern and Norfolk & Western (7 each), Southern (6), and Chicago & North Western, Quebec North Shore & Labrador and Western Pacific (5 each). IBM supplied 173 of the total number, RCA/Univac 23, Honeywell 15, General Electric 11, NCR 8, Burroughs 7, Collins 6; and other manufacturers, 13.

As for current applications of minicomputers in the railroad industry, the survey showed a wide assortment of uses, just to name a few—Track Geometry Car, Engineering, Locomotive Simulator, Classification Yards, Automatic Car Identification, Hot Box Detectors, Centralized Traffic Control, Inventories and Traffic Studies.

Montreal orders Westinghouse computer control system

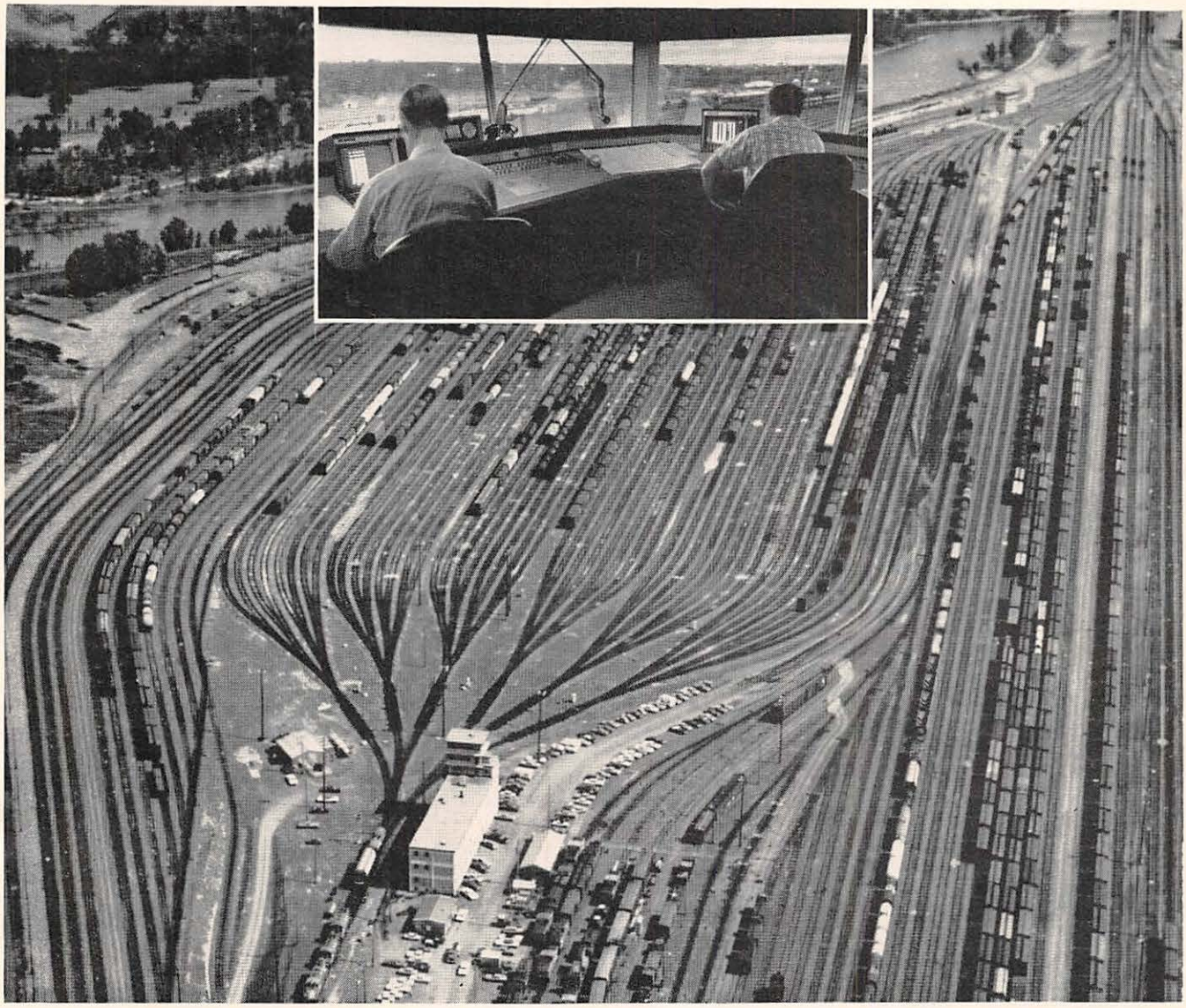
Westinghouse has been awarded an $18.6 million contract to supply a centralized control system to the Montreal Metro subway system.

The equipment will control train traffic, electric power distribution and auxiliary services throughout the entire system from one central location. In addition, the central computer will supervise train scheduling and routing for maximum efficiency and energy conservation.

The Montreal Metro, which is under the jurisdiction of the Montreal Urban Community, has been operating the rubber-tired, underground transit system since 1966 with over 15 miles of track and 28 stations. The system will be expanded during the next four years to 48.6 miles and 86 stations.

The Westinghouse equipment will come from locations in both Canada and the United States. Westinghouse Canada will be supplying central control operator consoles and displays, cir-

CONTROL FOR 3,000 CARS A DAY: WABCO CONTROL.



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RSC News

(Continued from page 6)

cuit breakers, station and tunnel signaling equipment and cables. Westinghouse Canada will supervise the installation. The system will have eight Westinghouse computers and 92 multiplexed communications systems. The computer and communications equipment will be designed and built at the industry systems division at O'Hara Township near Pittsburgh, and at the computer and instrumentation division at Orlando, Fla.

AMTRAK orders cab signals

Union Switch & Signal Division of WABCO has received an order from AMTRAK for cab signal and train control equipment to be installed on 70 new diesel locomotives. This equipment is used for operation over the Penn Central, Richmond, Fredricksburg & Potomac, Illinois Central and Union Pacific. AMTRAK's purchase of this equipment is part of a program to provide more efficient passenger-train service on all its routes.

Regulations committee is established

The Land Mobile Communications Council has established an International Radio Regulations Committee to participate in governmental proceedings involved in formulating U.S. positions for the World Administration Radio Conference in 1979.

Named chairman of the LMCC International task force is Hugh M. Robertson, Association of American Railroads.

LMCC President E. W. Downer said the committee will work with governmental agencies already making preparations for the 1979 WARC conference and will represent LMCC in pre-conference hearings leading to development of U.S. policy.

FRA is urged to study safety of tracks not equipped with signals

The National Transportation Safety Board has recently urged the Federal Railroad Administration to study the risks of train accidents on track not equipped with automatic signaling.

The board's recommendation is made in its report on a fatal accident in which a freight train's collision with a standing locomotive was unavoidable before the train's engineer could see that a manual switch ahead was misaligned.

The southbound 124-car Missouri Pacific freight was diverted by the switch off the main line onto a paralleling house track at Cotulla, Tex., last Dec. 1. The train struck an unoccupied MoPac locomotive which was standing on the house track less than 100 yards beyond the switch. All three head-end train crewmembers died in the collision, derailment and fire. The rear brakeman and the conductor at the rear end of the freight were uninjured.

The Safety Board determined that the probable cause of the accident was the "collision route" set up by "unauthorized operation of a switch by persons unknown." Contributing to the collision, the Board said, were railroad operating practices permitting speeds higher than the speed at which a train can stop short of a switch target which indicates the switch is properly aligned. Cited as contributing to the collision's severity was the crew's not seeing the switch misalignment and thus not applying brakes in time to slow the train significantly from its 40 mph speed before impact.

Safety Board investigation and MoPac test runs showed that the accident train's head-end crew could have plainly seen the switch target about 1,400 feet away, but the train needed 1,953 feet to stop. Automatic signaling would have given a warning well before a train reached minimum braking distance.

The Board noted that the only existing Federal requirement for freight train speeds where there is no automatic signaling is that 49 mph be the maximum. The effect of this, the Board said, "may be to promote operations at 49 mph where local ordinances and track conditions allow. This is unfair to train crews and the public because it assumes that all switches are properly aligned and secure and such an assumption is not justified."

Investigation showed a fracture in the switch stand latch mechanism which would have permitted the switch to be operated even though its latch remained padlocked. The Board concluded that the switch had been aligned correctly for the main track when last operated by MoPac personnel more than nine hours before the 8:30 a.m. accident.

The Safety Board recommended that Mopac review its operations on main tracks unequipped with automatic block signals and act to insure trains can be stopped short of misaligned switches; also to review rules interpretation problems disclosed by the accident and make rules and intended practices consistent, and to be sure all employees understand and comply with such rules.

The Safety Board recommended that the Federal Railroad Administration should: Consider in its study the need for uniform operating rules "the inconsistencies demonstrated" in the accident; assess "the current risks of train accidents involving misaligned switches, collisions, broken rails and other route obstructions on main tracks where automatic block signals do not exist," and issue regulations to replace the existing 49 mph requirements; require "positive indications of both normal and reversed switch positions on main tracks" not automatic-signal equipped; and sponsor development and testing of manual switch security devices which are "more resistant to operation by unauthorized persons."

Research contract awarded to GTW

Grand Trunk Western has received a $999,000 contract from the Federal Railroad Administration to share costs for research results from Grand Trunk's new $8 million electronic RAILS information system.

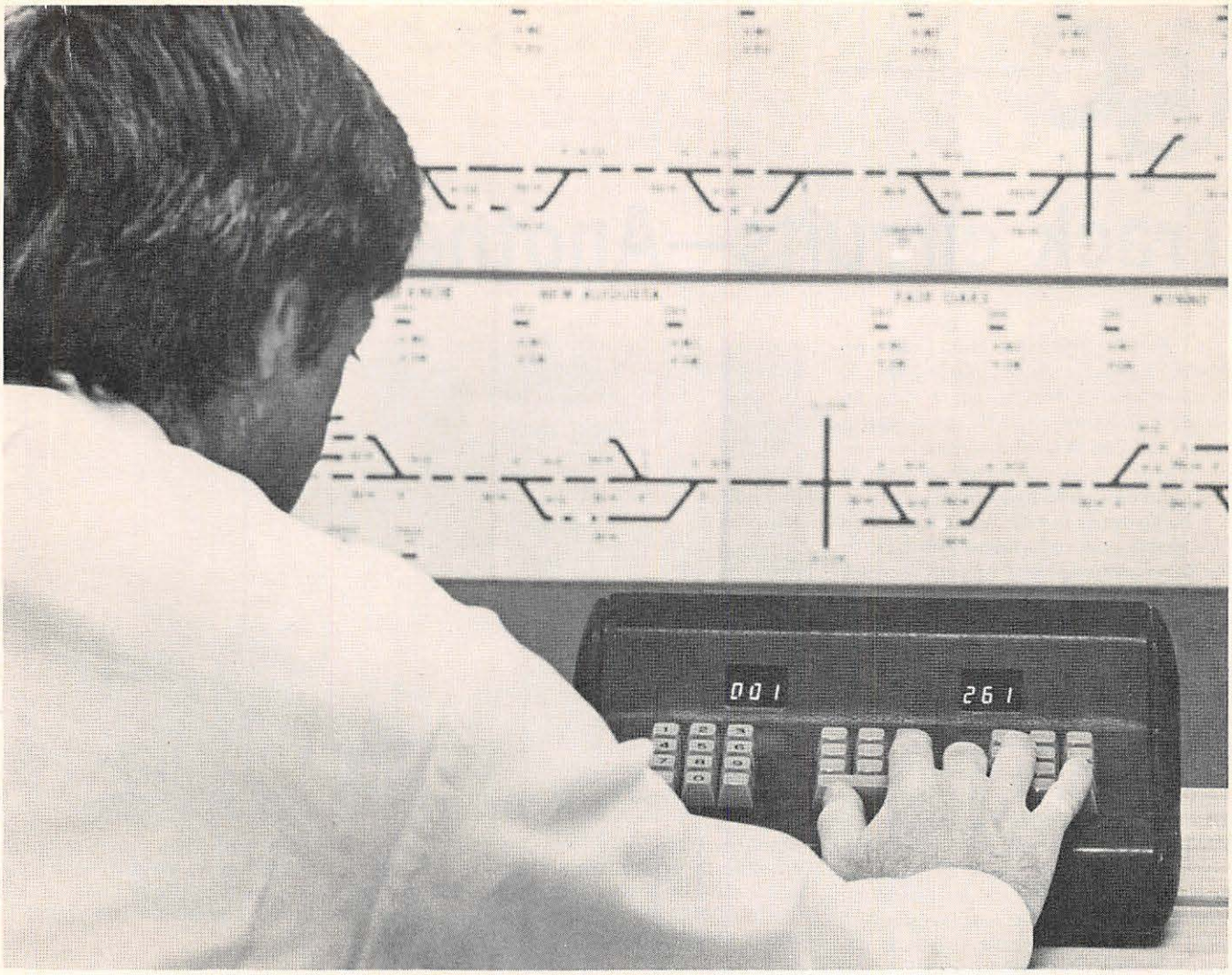
Last year, GTW embarked on development of a computer network providing almost instantaneous inventory of car movements, operations and revenues which will make it the first railroad in North America with a completely automated information system.

The Federal Railroad Administration has agreed to share $999,000 over a 36-month period to obtain results and statistical models which can be utilized by other railroads.

The GTW computer network, now being installed to cover the entire railroad in Michigan, Illinois, Indiana and Wisconsin by 1975, is a system of various wheel sensors and 61 scanners alongside the tracks. Collected information is fed into four regional computer stations and ultimately to Detroit, Mich., main computers.

Howard M. Tischler, general manager of information services for Grand Trunk, announced that the government contract calls for development of mathematical software models of yards and linehaul portions of GTW.

"We will provide statistical information to demonstrate improvement of railcar movements," Tischler said, "and we will be working with Stanford Research of Menlo Park, Calif., to provide these models.



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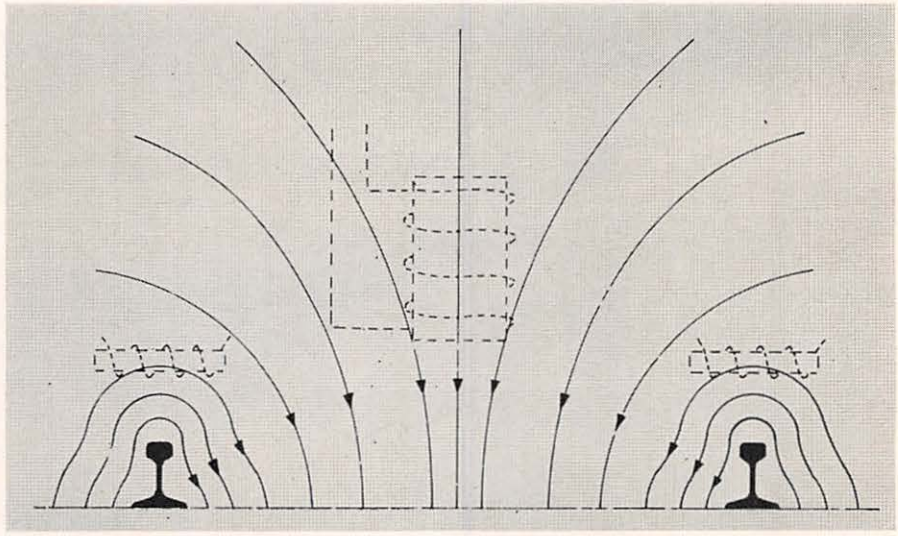
RAILWAY SYSTEM CONTROLS

Track circuits—Another role

A. E. H. Jeffries, Chief Engineer, British Railways Headquarters, and a member of The Institution of Railway Signal Engineers, recently presented a paper in London, which summarized some of the more innovative designs in track circuits and their applications as a reliable track-to-train communication link. Jeffries not only points out some of the inherent properties of various track circuits, but also reviews some of the limitations of certain designs.

Jeffries began by observing that because of the trend toward higher speeds on today's rail systems, emphasis is being placed on improving and developing equipment which enables the engineer to maintain a high level of safety for train operations. He also notes that it's important "to assist the engineer by attempting to provide, by an alternative source, that information which can, in general, otherwise only be gained by observation of lineside features, and by route knowledge." Following is a detailed summary of Jeffries paper.



Arranging pick-up coils to the rail offers an advantage of high signal strength but, due to erratic train riding characteristics, variation in magnitude of the signal may be great. A centrally-mounted antenna would partially compensate for the increased distance by a larger flux "window", whereupon the signal is largely independent of vehicle ride.

The use of the track circuit (invented in the United States over a century ago) for train detection has so spread that today it forms the fundamental component of most automatic block signaling. The use of track circuits for track-to-train communication also has a considerable history, as records indicate that relevant patents began to appear in the 1920s, at a time when electronic technology was in its infancy. The first practical application of track-to-train communication appears to have been on the Pennsylvania Railroad in 1933.

While this second role of track circuits has been in existence for some time now, the concepts involved are fundamental and can therefore never be considered obsolete. It is conceivable that this second role of track circuits could have as great an impact on the railway of tomorrow as the primary role, that of train detection, has on that of today.

Detection arrangements

The basic concept of the track circuit is to isolate a section (block) of track and to inject electrical energy at one end of the section and detect it at the other end. When the track circuit is shunted by a train the current from the transmitter (or feed) passes through the leading axle of the train. The track circuit current then passes in the rails beneath that part of the train ahead of the leading axle. Provision may be made to detect the track circuit current with an antenna, or pick-up coil, mounted under the front of the train so that a mutual inductance exists between the antenna and the rail/axle circuit.

In order to obtain maximum mutual inductance between the rail/axle and pick-up circuits, the antenna should collect as much as possible of the magnetic flux resulting from the rail current. The flux distribution is somewhat complex, being affected by ferro-magnetic material on the track and on the train. Maximum flux is felt near the rail surface so consequently the strongest signal may be obtained by positioning the pick-up coils as close to the rail as possible.

Another very important criterion is the degree of variation in magnitude of the received signal because of train riding characteristics. Since flux density is greatest close to the rails, relatively small changes in the antenna-to-rail distance can cause a large variation in signal level.

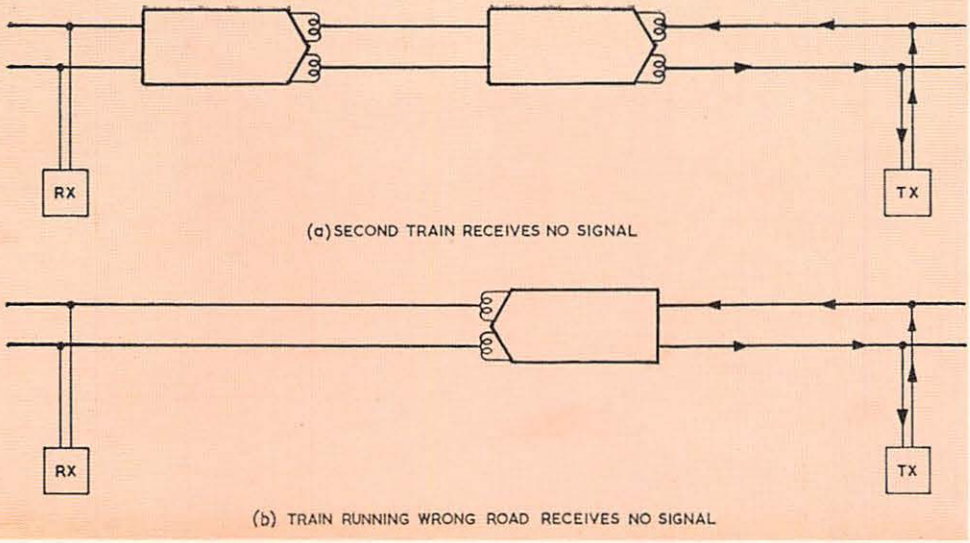
Mounting a pick-up coil so as to sense the axle current has its merits but due to traction equipment which frequently takes up the space around the shunting axle the method has its physical problems.

A single, centrally-mounted antenna would partially compensate for the increased distance from the rail by a larger flux "window", whereupon the signal is largely independent of vehicle ride. To concentrate the available flux, the antenna takes the form of a coil wound on a specially shaped ferro-magnetic yoke.

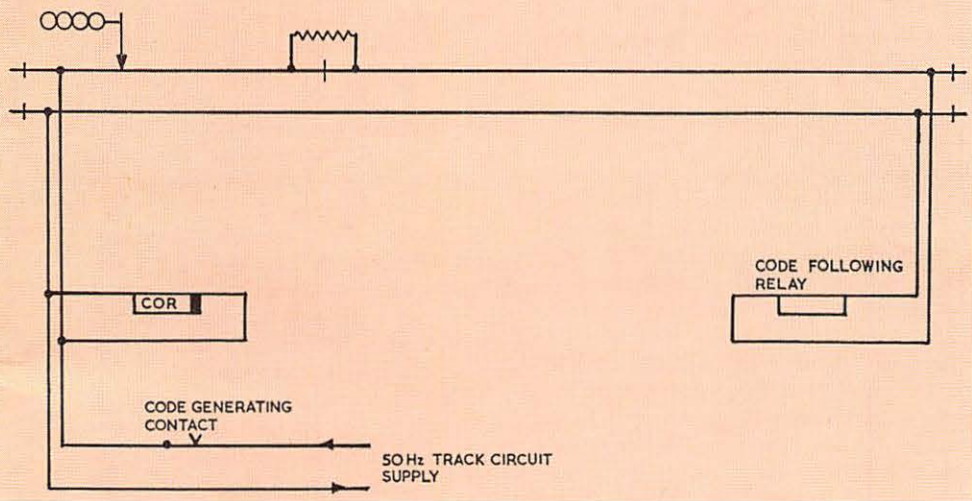
The effects of traction current in electrified territory can be minimized by suitable antenna design.

Information transmission

In order for the track circuit signal to be received, an alternating current signal must be used, and the higher the signal frequency, the greater the receiver signal level. For information transmission a system of coding must be applied. Information will generally take

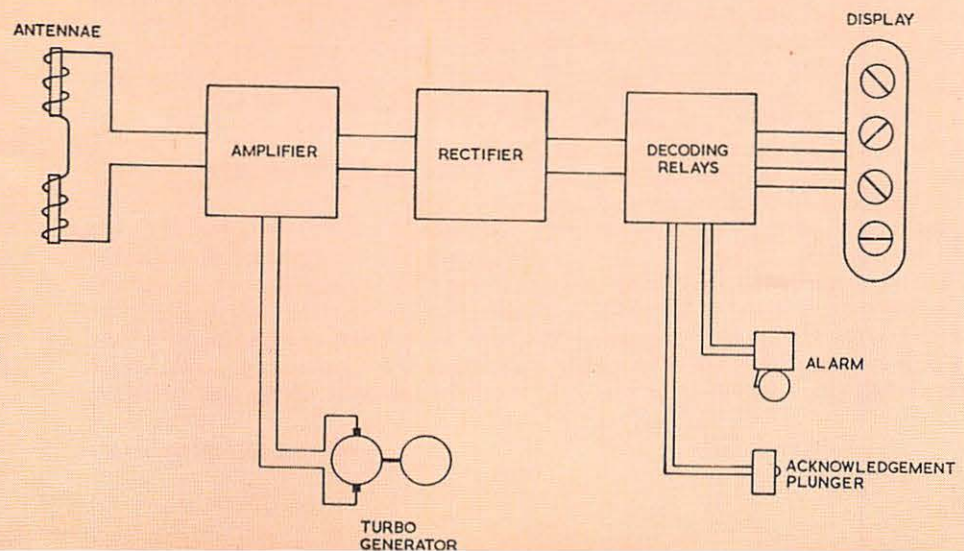


Two inherent properties of track circuits are clear advantages for cab signal applications.



Block diagram of the track circuit used in early British tests.

Block diagram of the train-borne equipment used in early British tests.



the form of several two-state channels, one of which can be energized at any one time.

Using one unique track circuit frequency for each channel, while simple in theory, would require a great deal of equipment since a separate detection circuit is required for each channel. A general practice is to use one or more basic carrier frequencies which are modulated with the required information. Modulation may take any form—amplitude, frequency, pulse, frequency shift keying, etc. Development of track circuit transmission is very closely linked to that of coded track circuits so consequently a popular technique is to use simple on/off keying employing frequency codes. With this type of transmission, pulses of alternating current are fed to the rails at various repetition rates to distinguish the various codes. After suitable amplification of the trains received signal, special code following relays provide the necessary indication.

Basic carrier frequency may be any regular track circuit frequency but at higher frequencies, the problem of rail attenuation must be offset by improved antenna coupling.

Inherent properties

The track circuit has two important advantages for use in connection with cab signalling. First, any one signal cannot be received by more than one train simultaneously since the leading axle of the train nearest the transmitter shunts the signal. Second, a train cannot receive a signal intended for trains running in the reverse direction since the antenna is mounted at the leading end of the train and the other axles would short the track signal. For this reason the track circuits must be arranged so that the train is always running towards the transmitter. On bi-directional lines, either the transmitters and receivers can be switched appropriately, or two independent track circuits, can be superimposed using different carrier frequencies.

Limitations

For any signaling installation, safety must be the prime consideration. There must be no chance of a train receiving a signal which is not intended for it. Such a signal could be received from circuits in the adjacent block, either directly or due to insulated joint failure. Variations in signal level due to tolerances and effects of rail attenuation coupled with distance between the train and the transmitter make it essential that the trainborne receiver accept a specified range of signal levels and avoid response to weak signals from an adjacent track.

To ensure that a train can only respond to signals of the appropriate frequency, it may be desirable to prove the integrity of insulated block joints or utilize different carrier frequencies for adjacent tracks.

Due to severe rail attenuation at high frequencies, the restricted bandwidth available for information transmission has imposed a severe limitation on the technique. At high frequencies, rail signal strength varies greatly according to the distance from the transmitter. As a consequence the trainborne receiver would have to respond to a wide range of signal strengths yet avoid response to weak signals from an irregular source. To reduce rail attenuation at higher frequencies compensating capacitors connected across the rails at regular intervals may be effective. After compensation, the track behaves like a transmission line and "standing waves" will be set up, unless the terminations are matched. Although the rail signal may be somewhat erratic during shunting, the total variation and minimum signal level are greatly improved. Additional benefits such as stabilization of ballast resistance and broken rail detection are also derived from the use of compensating capacitors.

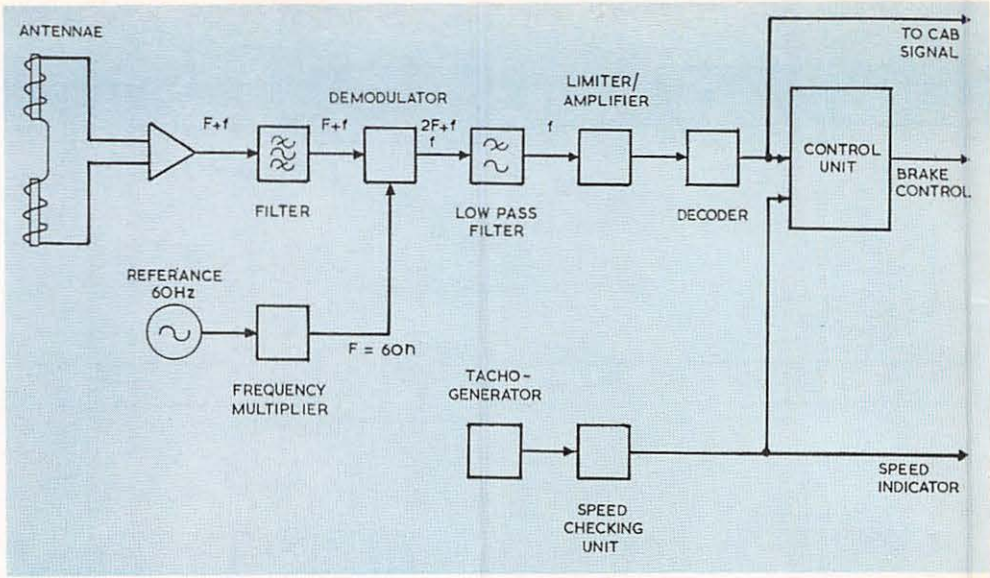
Practical system

How can a limited amount of information, due to the limitation on bandwidth, be used for practical train control system? The simplest concept is continuous cab signaling in which the aspects of waywide signals are displayed in the engineer's cab.

With modern signaling installations, the engineer is not actually required to act on a signal until the leading vehicle passes it. The system could, therefore, be arranged so the corresponding cab aspect will be displayed as the train passes the signal. In this case the cab aspect would correspond to that of the signal in the rear.

Two disadvantages of this technique are: no allowance is made for driver reaction time and a contradiction exists between the cab and wayside aspects on approaching a signal. An alternative is to indicate the aspect of the next signal in advance. Although this approach may encourage the engineer to react too early, this may be an advantage of increased braking distance for high speed trains.

A third approach, which has been accepted as the most appropriate in the event of adapting cab signaling to British signaling practice, is to establish a change-over point at a fixed distance on the approach side of each signal, roughly corresponding to the signal sighting distance.



Tokaido Line train-borne equipment indicates the probable future trend.

Early British application

In 1948, an experimental installation of cab signaling adapted to British style multiple-aspect signaling used 50 Hz track circuits with modulation at 3, 2 and 1.25 Hz, representing the green, double-yellow and yellow aspects, respectively. Absence of coding signified red.

Two pick-up coils wound on laminated iron yokes were mounted within about six to eleven inches above each rail. The signal was amplified, rectified and used to operate a code-following relay. Resulting pulses were then decoded and operated the trainborne aspect relays which illuminated the cab display.

An auxiliary relay located at the track circuit transmitter was incorporated to operate the aspect changeover, which functioned by detecting the voltage drop across a resistor wired in series with the rail at a point 200 yards rear of the signal. The relay remained energized until the train passed between the resistor and the track feed. The aspect changeover represents an attempt to reconcile the conflict which arises in positioning the track circuit terminations, between the requirements for train detection, and those for cab signaling. It is standard practice to locate the track circuit terminations at the overlap point such as 200 or 300 yards in advance of the signal. To update the cab aspect at a point in the rear of the signal, it is essential to utilize some form of auxiliary track circuit receiver or the number of track circuits required will be doubled.

Another approach, used with continuously welded rail, is to use a coil located in the track which couples with the rail current and provides an output only when the section between the transmitter and the coil is not shunted by a train.

Speed signaling

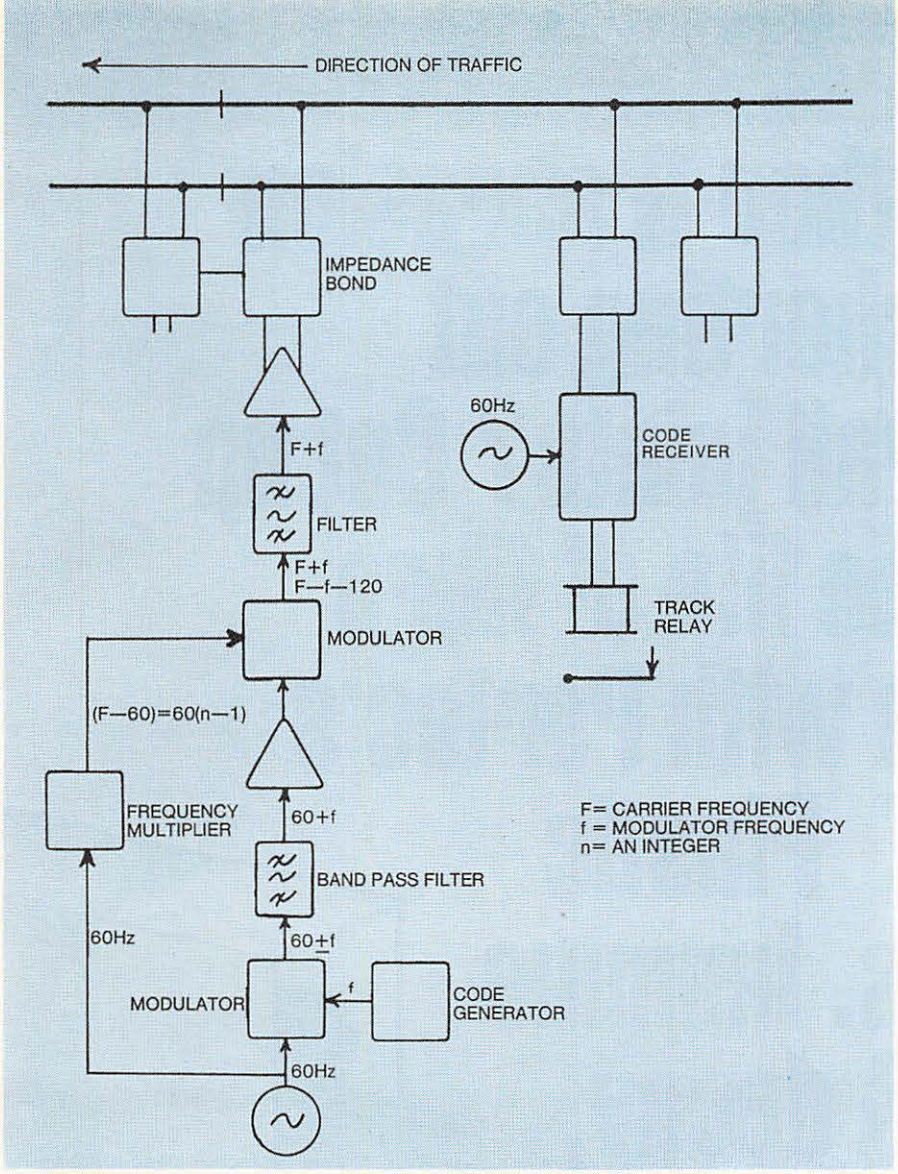
The multiple aspect system based on route signaling has now become firmly established in Britain, in preference to "speed signaling" although speed signaling can offer better regulation of traffic, especially in relation to speed restrictions and junctions, and also making the engineer less dependent on reliable route knowledge.

In Britain, these considerations appear to have been outweighed by the difficulty of providing lineside speed information with economy and clarity, together with difficulties caused by variation in braking performance.

Information transmission by way of track circuits has opened up the possibility of providing speed information right where it is needed, in the engineer's cab, and thus overcoming the main objection to speed signaling. The speed information being transmitted is controlled by the lineside signaling equipment so that the speed of the train is regulated in accordance with block occupation, permanent and temporary speed restrictions, and junction speeds. The use of speed information permits a full range of control from an advisory system to possible ultimate full automation of the driving function.

Various systems in use

In the United States, the ICC has required that continuous cab signaling be installed on any line where passenger services operate at speeds of 80 mph or greater. The systems in use conform to a classic design, coded track circuits operating at the industrial fre-



Tokaido Line track circuit applies advanced electronic techniques.

quency of 60 Hz, or at about 100 Hz. Information transmission is by means of on/off keying with frequency codes of a few Hertz. Trainborne equipment used in British tests is, in general, similar to the American practice.

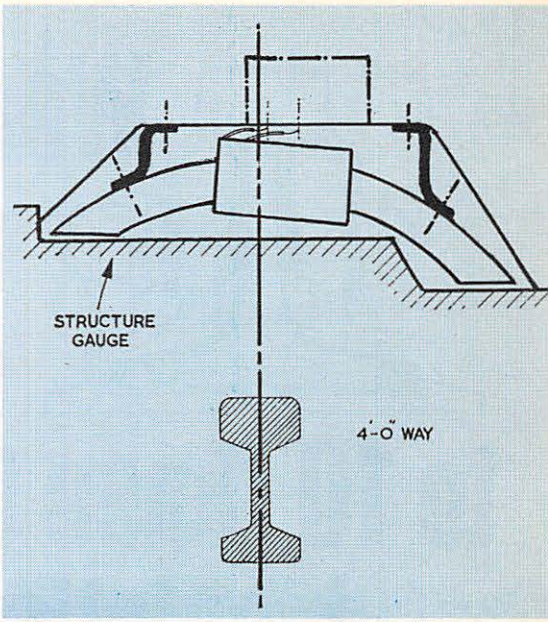
The cab aspects are updated on passing the lineside signal with system reaction time not exceeding eight seconds. No provision for driver reaction or sighting time is made other than the section length.

Notable installations of cab signaling in Europe include applications in the Netherlands, Italy and the Soviet Union.

A comprehensive system of speed signaling in use on the Netherlands Railways makes use of 75 Hz coded track circuits with frequency codes between 2 and 4 Hz, corresponding to five speed levels. When a restrictive speed indication is received a compulsory brake application is initiated which is released when the speed is reduced to about seven mph greater than the indicated speed. The 25 mph code also signifies "stop on sight of red signal", and a device requiring the engineer to respond at 20 second intervals is activated.

To prevent disturbance to the train detection function of the track circuits, the coding is initiated by a de-energization of the track relay so that the coding is only present when the track is occupied.

In the United Kingdom, the only current use of track circuits for train control is 13 miles of the Victoria Line which runs from Walthamstow to Brixton beneath the heart of London. The track circuits operate at 125 Hz and are coded as follows: 2 Hz—Stop, 3 Hz—Coast not faster than 22 mph, 4.5 Hz—Run not faster than 22 mph, 7 Hz—Run at full line speed. One trainborne antenna is provided for each rail, each with its own amplifier and decoder unit. The units are cross checked for correspondence and two outputs are provided, one to traction control equipment, and a second to a safety interlocking unit. The safety interlocking unit also has inputs from a speed checking governor and unless the speed of the train corresponds to that of the track circuit code, the brakes are applied.



Victoria Line train pick-up coil.

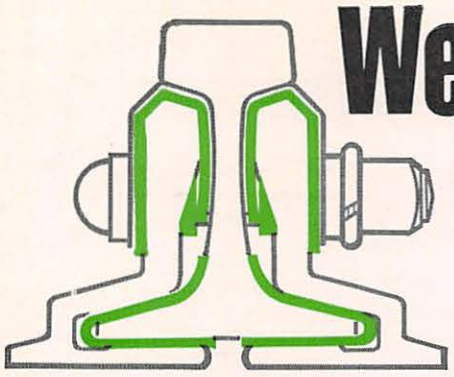
A secondary system of rail circuits is also featured in which audio frequency signals are injected into 10 foot lengths of rail at spot locations to provide speed commands for the automatic driving equipment. The audio signals are received on the train by additional pick-ups similar to those used for the safety information. This secondary system is not regarded as fail-safe and the track circuits serve as a back-up in case of failure.

The Victoria Line installation has all information required for full automatic driving of the trains conveyed via the running rails.

Still another system, found on the Tokaido Line in Japan, has no lineside signals and control is effected by means of track circuits for headway, speed restrictions and station stops. The system is based on six speed indications as follow:: 0 Hz—Stop, 36 Hz—18.6 mph, 29 Hz—43.4 mph, 22 Hz—68.2 mph, 15 Hz—99.2 mph, 10 Hz—130.2 mph.

Track circuit sections are 1.86 miles in length and on approach to an occupied section, two block sections are used for braking. The track circuits are of the double rail type with impedance bonds. Four carrier frequencies are used, 720 and 900 Hz for the Up line and 840 and 1020 Hz for the Down. The frequencies are used alternately for each line and the carrier is frequency-locked to the 60 Hz traction supply to avoid interference. Single sideband amplitude modulation is used so that the rail current frequency is equal to the sum of the carrier and modulation frequencies.

Trainborne equipment includes twin pick-up coils mounted 8 inches above the rails at the leading end of the train. The signals received operate the braking control. The braking control is un-



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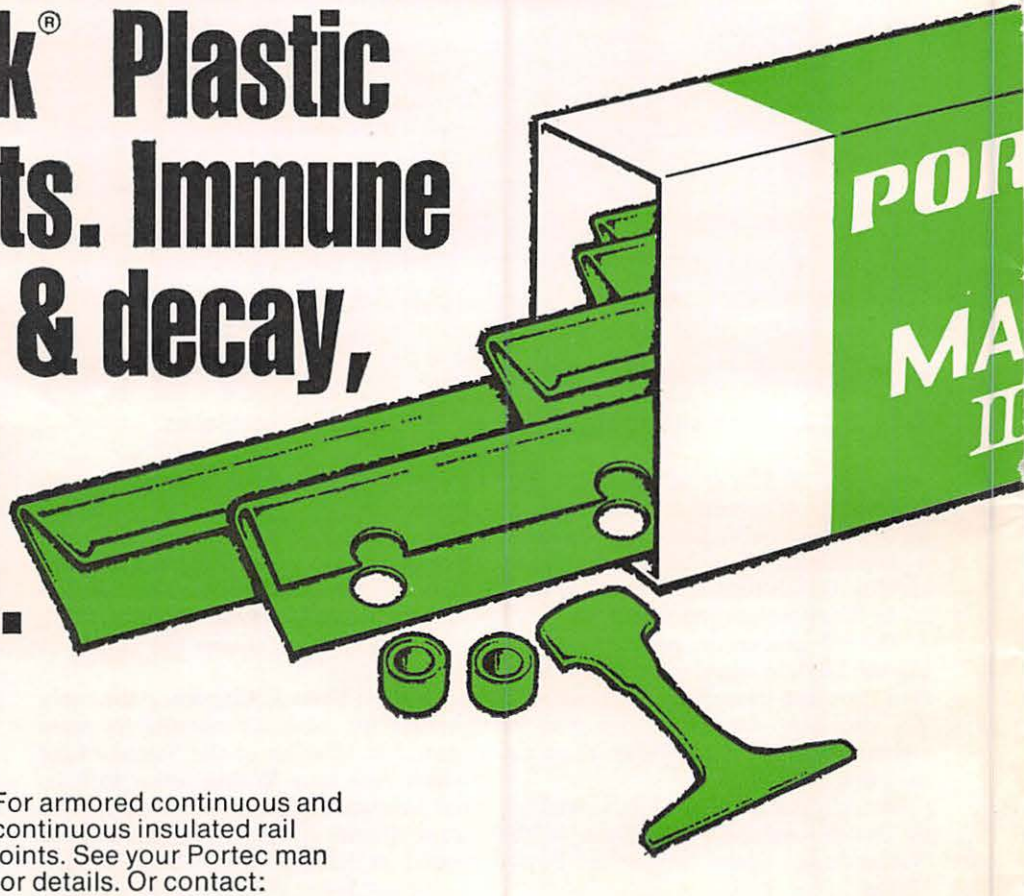

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der the supervision of a logic unit, which in addition to the track circuit codes, has an input from an axle-mounted tacho-generator.

Prospects for the future

Much of the coded track circuit equipment in use in various parts of the world today follows the classic pattern established in the United States, with industrial, or near industrial, frequency track circuits and frequency codes at a few Hertz. The Japanese example indicates the probable future trend, with greater utilization of electronic techniques, and achieving track circuits with higher frequencies and more sophisticated modulation, thus providing a greater information capacity.

Another trend is to incorporate a facility for track-to-train communication into track circuits which have otherwise desirable features, such as elimination of insulated joints, or use of high-voltage pulses to break down insulating films on the rail head.

In order to illustrate these trends, two examples of systems incorporating these features follow.

RABIC

Compagnie De Signaux Et D'Entreprises Electriques (C.S.E.E.) of Paris, France, manufactures the RABIC system featuring the transmission of ten information channels utilizing jointless track circuits. The system is capable of operation on both AC and DC electrified lines. The track circuits use a "tuned rails" principle and four basic frequencies of 1700, 2000, 2300 and 2600 Hz. The use of four frequencies is made to avoid interference from adjacent track circuits by suitable staggering. On any one track only two of the four basic frequencies are used and the trainborne receiver features a bistable switching mechanism so that the equipment is only responsive to the correct pair of frequencies. The frequency pair selection is activated by selection tones transmitted by a short loop of cable in the track at the entry to the section.

The basic feature of the RABIC system is the frequency modulation of the track signal which serves a dual purpose of conveying information to a train, and to render the track circuit signal distinguishable from any harmonics of the electric traction supply.

Frequency deviation and modulating frequencies are low so as to permit satisfactory operation with the tuned circuit techniques employed for track circuit separation and track-to-train transmission. The frequency deviation is plus or minus 10 Hz and the modulation frequencies are between 12.2 and 28.1 Hz.

The track circuit transmitter consists of a pilot oscillator which generates a frequency-modulated signal which is amplified by an output power amplifier. The modulation input to the pilot oscillator is derived from a divide by 28 circuit which is fed from a separate modulator unit. The modulator unit in turn comprises a signal generator with frequency control exercised by the external signaling relay circuitry. The track circuit receiver also incorporates stages which check that the rail signal is correctly modulated and a fail safe delay circuit.

The trainborne receiver unit of the RABIC system uses a single, centrally mounted antenna made of four coils wound on ferrite rods, contained within a wire gauze electrostatic screen. The antenna and a pre-amplifier are mounted within an epoxy resin enclosure.

The antenna is responsive to the track circuit signals and to the selection tones from the track conductor, which are distinguishable by increased magnitude and are selected by a threshold circuit.

On reception of the selection tones, the appropriate carrier amplifiers are activated and the output from the appropriate carrier amplifier is selected by a "carrier present" relay and passed to a demodulator circuit. An interlock is incorporated so that only one carrier signal can be selected. The demodulator converts the frequency-modulated signal into an amplitude-modulated signal which is passed to an envelope detector which recovers the original low-frequency modulation signal.

A separate selection circuit is provided for each of the ten modulation frequencies and comprises five tuned frequency-doubling stages, followed by a relay driver circuit. The use of frequency multiplication avoids the requirement for high stability circuits at low frequencies.

The output of the unit comprises ten interlocked relays and may be used to operate a cab display or traction control equipment. By the use of a multiplex technique, the basic system is capable of providing up to 45 information channels.

Jeumont-Schneider 'Impulse' system

A version of this system is in use to provide cab signaling on the new Paris RER line, but an expanded version has now been developed, with up to 10 channels.

Tuned circuits are not used with this system but instead it incorporates the "impulse" track circuit which functions

(Continued on pg. 24)

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1. Title: SECONDARY BATTERY NICKEL IRON ALKALINE STORAGE TYPE

2. Definition:

(a) Secondary Battery: A combination of two metals or metalloids immersed in an electrolyte which in itself will not produce electrical energy without first having the metallic portion of the element decomposed by the passage of electric current.

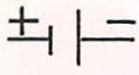
(b) Storage Cell: A secondary cell for storing electrical energy at one time for use at another time.

(c) Charging: The process of putting energy into a battery.

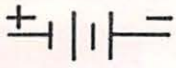
(d) Discharging: The process of taking energy out of a battery.

(e) Electrolyte: The fluid surrounding the elements of the battery.

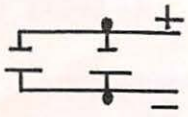
3. Symbol:



Single cell



Two cells in series



Two cells in parallel

4. Description:

The nickel iron battery consists of three essential components: positive active material which is nickel oxyhydrate, negative active material which is metallic iron sponge and the electrolyte which is potassium hydroxide and water with lithium hydroxide added.

The positive material is encased in perforated nickel plated steel tubes. The negative material is encased in flat, perforated nickel plated steel pockets. The plate is formed by grouping the desired number of tubes or pockets and crimping or welding them to a nickel plated sheet steel frame. The cell container is of nickel-plated sheet steel insulated from the elements by hard rubber or plastic. See Fig. 1.

Note: The last U.S. manufacturer of the nickel-iron battery will discontinue production of this battery early in 1975. Although this line of batteries will be discontinued, some railroads will continue to put nickel-iron batteries in service until existing stocks are exhausted. The manufacturer advises that parts and electrolytes will be available for at least 5 years.

5. Purpose and Application:

The nickel-iron storage battery is used as a dc power source at locations where an ac charging source is available. It can be used for track circuits, signals, highway crossing protection or for any railway signal appliance or circuit that requires direct current.

6. General Information:

The nickel-iron battery is especially adaptable under conditions of dirt and corrosion and where rough handling may be encountered. The rugged construction of the cells contributes substantially to their long life, thus shedding of active materials from the plates is virtually impossible.

One important advantage of the nickel-iron battery is that it can be stored almost indefinitely without attention.

The cell containers are metal and must be insulated from adjacent ones and other conductive materials.

The nominal voltage of a nickel-iron cell under load is 1.20 volts. The actual voltage depends on whether the cell is on open-circuit, charge or discharge. Open-circuit voltage may vary from 1.25 to 1.35 volts. When the cell is connected to an external load, its voltage will fall to a value dependent on discharge rate and state of charge. If the rate is held constant, the voltage decreases until it reaches a point where the cell is considered normally discharged. This is termed "final voltage", and it varies with the rate of discharge. A commonly used final voltage is 1.14 volts per cell.

Some general rules for storage battery installation and maintenance:

(a) Check polarity and connections when installing.

(b) Maintain proper charge.

(c) Maintain proper electrolyte by adding water but do not overfill.

(d) Keep battery dry and clean.

(e) Avoid flames or sparks around battery since discharged gases might explode.

(f) Keep vent plugs in place and tight.

(g) Check terminal nuts at regular intervals and tighten if necessary.

(h) Keep terminals coated with grease as specified by railroad maintenance instructions.

(i) The electrolyte is alkaline and is injurious to skin

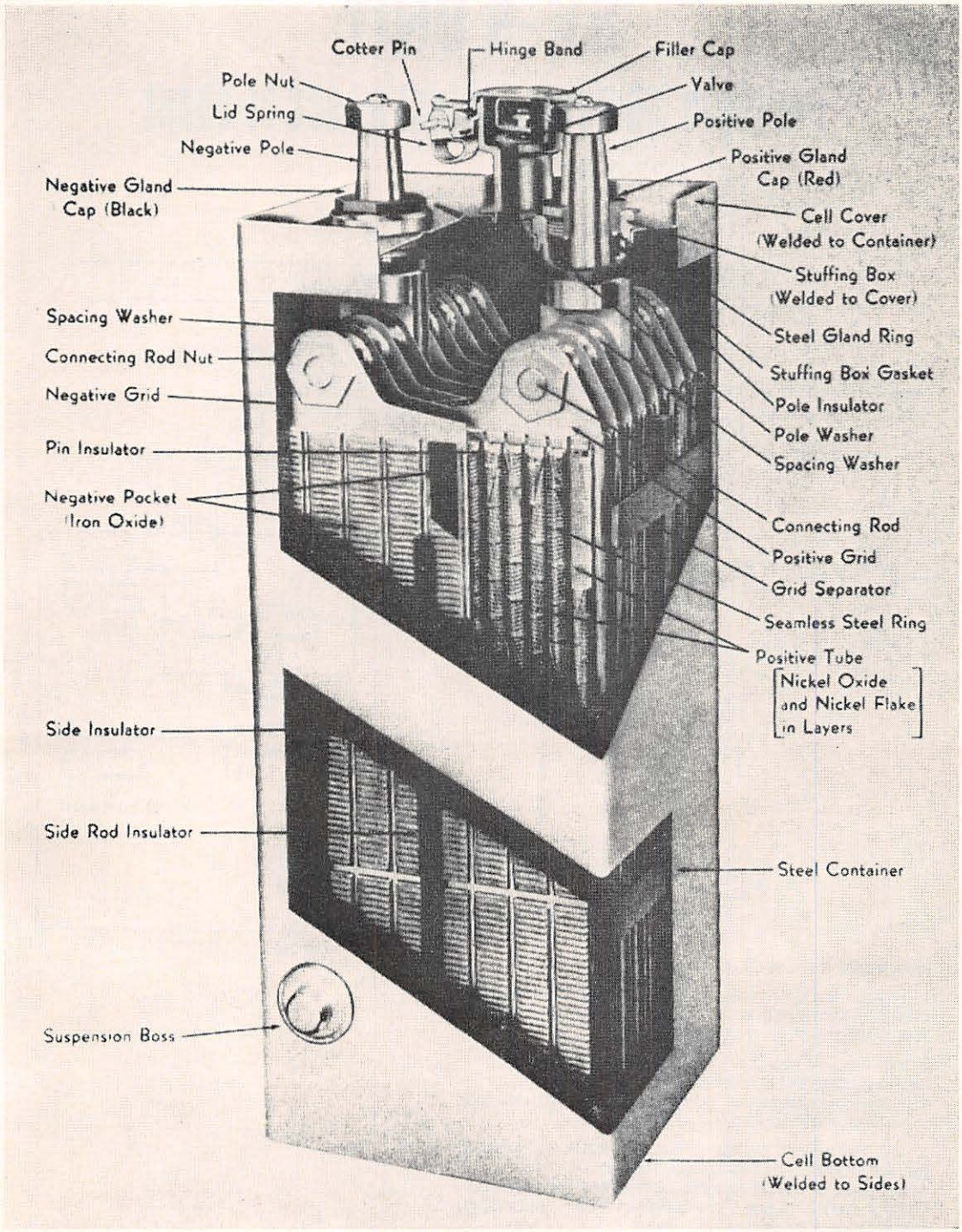


Fig. 1

Nickel-Iron-Alkaline Storage Cell

and clothing. If contact occurs, wash immediately with water.

7. Detailed Operation:

The nickel-iron battery has a nickel oxyhydrate positive plate, iron sponge negative plate and potassium hydroxide electrolyte. When the battery is discharged, the positive plate is reduced to a lower oxide and the iron negative plate is oxidized. The reaction is mainly an oxygen iron transfer between plates. The specific gravity of a new cell is 1.160 to 1.190 at 25C (77F) and at normal solution level. As no constituents of the electrolyte combine with the active material of the plates, the specific gravity does not change appreciably during charge or discharge, and therefore it does not indicate the state of charge or discharge.

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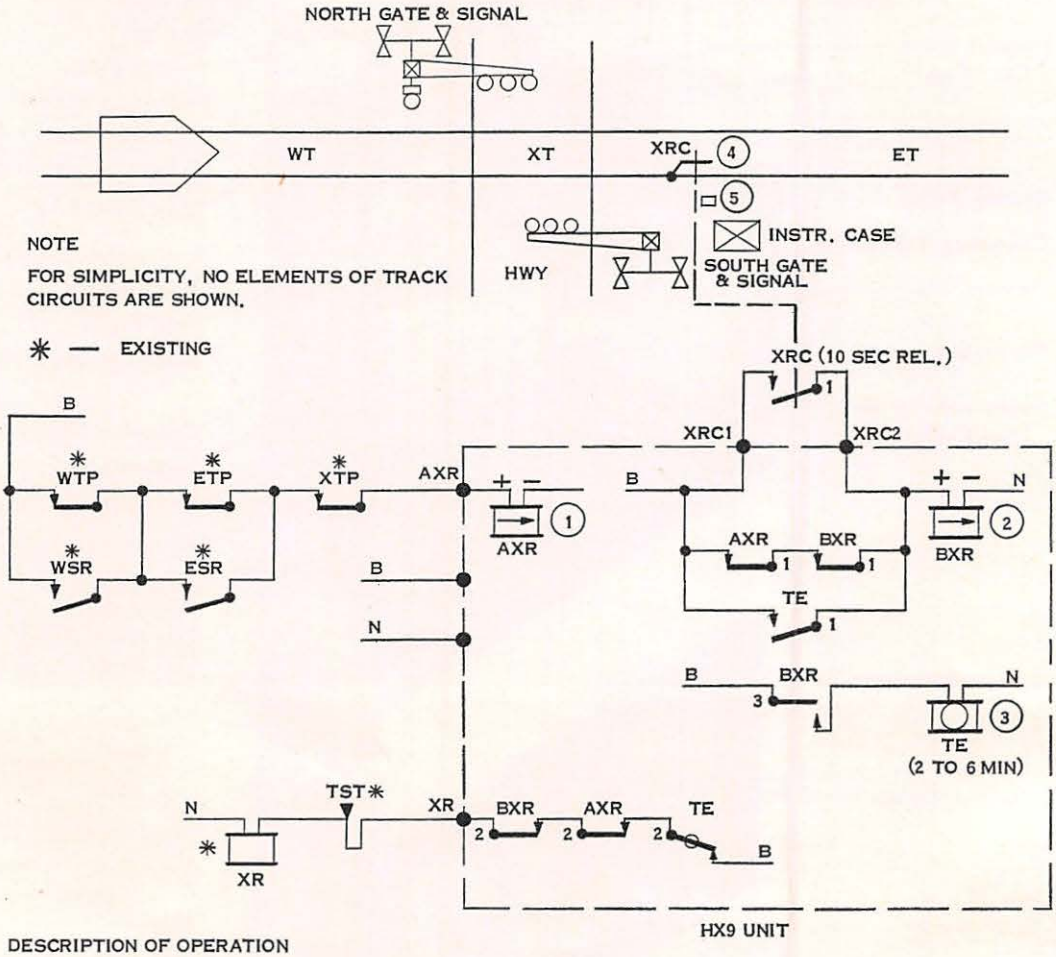

DESCRIPTION OF OPERATION

1) ASSUME AN EAST BOUND TRAIN ENTERING WT TRACK CIRCUIT, APPROACHING THE XING, AND CAUSING AXR, BXR, AND XR RELAYS TO RELEASE.

2) BXR RELAY, BEING A STICK RELAY, WILL STAY DEENERGIZED EVEN IF THE TRAIN LOSES SHUNT. THE EXISTING XR RELAY CONTROLLED BY AXR AND BXR REMAINS DEENERGIZED.

3) THE TRAIN NOW ENTERS TRACK CIRCUIT ET, AND AXR RELAY PICKS UP IN THE USUAL MANNER. SILEC RAIL CONTACTOR XRC, ACTIVATED BY A WHEEL OF THE TRAIN, CLOSES ITS CONTACT FOR 10 SEC THUS ENERGIZING BXR RELAY. XR RELAY CONTROLLED BY AXR AND BXR BECOMES ENERGIZED.

4) IF A TRAIN ENTERS WT OR ET TRACK CIRCUIT AND RETURNS WITHOUT GOING THROUGH THE XING, OR IF FOR A WEST BOUND SLOW MOVING TRAIN SILEC RAIL CONTACTOR XRC RELEASES BEFORE AXR RELAY BECOMES ENERGIZED, BXR RELAY WILL BE RESET BY A CONTACT OF TE RELAY.

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Progress in railroad research

Starting in 1970 the research and test function of the Association of American Railroads should provide a solid scientific and engineering base to meet the needs of the railroads in the 1970s and beyond. This conclusion came from an intensive study by the AAR's Committee of railroad executives qualified in scientific and engineering principles. Newly emerging concepts would need to be applied to the railroad industry. Less emphasis would be placed on studies of a particular piece of hardware itself but instead studies would now concentrate on how that piece of hardware related to the system of which it is an integral part.

The Research and Test Department of the AAR has recently released a detailed report listing the accomplishments of the second two years of work done by the department during 1972 and 1973.

What does the report have to say about research being conducted in the area of signaling? In the past, the AAR Research and Test Department has been relatively inactive in signaling research. Recognizing a need for study in this important area, planning was initiated in 1972 to consider the ways in which the department could respond to the needs of the industry. The issue of grade crossing safety emerged as the highest priority item in this area.

The first step in attacking the grade crossing safety issue was the massive crossing inventory program which began in June of 1972. Its purpose was to inventory, assign, and display identification numbers at highway-railroad grade crossings across the nation. This inventory would provide information for a system providing site-specific information regarding the location of all railroad highway intersections and a description of the physical operational characteristics of all public railroad-highway grade crossings.

AAR Technical Center participation in this effort has been limited to evaluation of proposed labels. Labels have been soaked in water, exposed to heat, and subjected to ultra-violet radiation to verify their suitability for the intended application.

The $4.4 million cost of the project is shared equally by the railroads and Department of Transportation's Federal Railroad and Federal Highway Administrations. The railroads will be reimbursed on a per-crossing basis for work performed installing number boards and collecting inventory information at each crossing.

Upon completion of the project, scheduled for December of 1974, a central file will be maintained in the Department of Transportation for use by the railroads and federal and state agencies responsible for programs involving rail-highway grade crossings.

The first major effort mounted by the Technical Center was a joint program with the Santa Fe. The program was initiated in Oct. 1972 and was directed to development of functional specifications for grade crossing warning systems. The objective was a coherent, coordinated set of specifications which would permit cost-effective procurement of warning equipment for all types and classes of grade crossings. A project team consisting of one research engineer from the AAR and one from the Santa Fe was appointed. The initial task of the team was to study existing literature and experience relating to grade crossing accidents, and near-accidents, characterize protection systems, and recommend areas for additional research.

Based on their initial study, the team prepared a preliminary draft of definitions of warning systems, arranged in order of protection afforded, and also established tentative performance requirements for the systems.

AFO

The second major effort in the signaling area dealt with the question of frequency standardization of Audio Frequency Overlay circuits. A preliminary survey of current systems revealed that, while the systems supplied by all the manufacturers of this equipment are self-compatible, a possibility of incompatibility between different systems exists.

A special committee for study of the problem was appointed in May 1973. This committee, including members from system suppliers, the railroads, and the AAR, explored the development of a single standard set of audio frequencies for AFO equipment. Criteria was proposed for frequency separation and avoidance of interference due to the possible presence of fundamentals, harmonics and the sum and difference frequencies generated by commercial power systems and railroad sources. The committee soon developed the fact that the problem was much more complex than had been expected, and that no simple solution is possible.

The project is now investigating the feasibility of modeling, on a computer, the track and system parameters which are involved. The objective will be a set of system performance specifications covering, for example, receiver bandwidth with sensitivity, transmitter bandwidth and power level, standard track attenuation, and modulation schemes as well as a set of standard frequencies.

A positive result of the preliminary study was a recommendation that only modulated AFO systems should be used. Although unmodulated systems have some advantage in initial cost, the standardization and system compatibility inherent in the modulated approach warrant adoption of this type of equipment wherever possible.

ACI

In early 1967 the AAR initiated a massive effort to evaluate systems for automatic car identification which would serve as the heart of a comprehensive national system. Several different concepts had been developed at that time. Based on a series of field tests, it was decided that the now familiar optical system using the retroreflective labels on rolling stock rated highest overall.

Early in the program, it was realized that the ability of optical scanners to read labels accurately and reliably would be the key element in the success of the system. A massive survey effort was mounted in mid-1971 to develop statistics concerning label condition and readability. As a result of the analysis of the survey, the AAR Technical Center initiated two studies which addressed the problem of improving service readability directly, and a third study which considered the more basic question of original label quality.

Dirt and contamination being the major cause of unreadable labels led to a search for some kind of clear coat on the label. It was felt that the coated label would have less tendency for tight adhesion of dirt and a cleaning process would be simplified. While studying many of the options available, one supplier of label material developed a method of improved surface treatment which, through laboratory and field tests, proved to provide a more easily cleaned label. A recommendation was made in October 1973 to make this type of label the approved standard.

Survey indicates high acceptance of Signal Training Bulletins

A questionnaire on Communication and Signal Training was distributed in the railroad industry during the past year. The survey, prepared by Committee G, was designed to indicate not only the acceptance of the new Signal Training Bulletins, but also to find out what type of training programs are being conducted on the North American railroads.

Although response to the questionnaire was rather disappointing to the Committee members, it is felt that the information received will be valuable in establishing priorities for future committee assignments. The most encouraging result of the questionnaire is that all signal-department replies indicated that they were already distributing copies of the approved Signal Training Bulletins to their personnel or that they would do so when a greater number are available.

Of the 25 replies received, about 25% of the answers were supplied by representatives of the signal departments, 25% by communication departments, and about 50% from representatives of communication and signal departments.

A summary of replies received in answer to the Communications and Signal Training Questionnaire follows:

1. Does your Railroad provide formal training for:

	Yes	No	No Answer
C	7	16	2
S	12	13	—
Total	**19**	**29**	**2**

2.

a. Is your training program covered by a formal agreement with the Brotherhood which represents the employees?

	Yes	No	No Answer
C	4	5	16
S	10	2	13
Total	**14**	**7**	**29**

b. Does the agreement contain clauses which require the employees to participate in the training program?

	Yes	No	No Answer
C	3	2	20
S	9	2	14
Total	**12**	**4**	**34**

c. Does the agreement require success in the training program as a condition for continued employment?

	Yes	No	No Answer
C	3	0	22
S	10	0	15
Total	**13**	**0**	**37**

3. What type training is conducted on your railroad? (See box)

4. Which employees require craft training most? (in order of priority)
   a. Communications
      Inside Plant—New Employees, Installers, Maintainers, Supervisors.
      Outside Plant—New Employees, Installers, Maintainers, Supervisors.
   b. Signals—New Employees, Maintainers, Inspectors, Installers, Supervisors, Engineers and Designers.

5. If training is not presently provided for your communication and signal personnel please indicate where you consider training should initially be directed.

New employees	Present employees	Both	No Answer
3	7	10	5

6. Do you consider the bulletins received to date can effectively assist in the training of new employees?

   Yes – 22 No – 0

7. Do you consider the bulletins received to date can be of benefit in upgrading present presonnel?

   Yes – 22 No – 0

8. Do you consider the bulletins received to date can be of value to introduce new engineers and technicians to the basic purpose and operation of signal equipment?

   Yes – 18 No – 4

9. Have copies of the approved bulletins been distributed on your railroad?

   Yes – 10 No – 12

   a. Who received copies?

All Employees	New Employees	Others	No Answer
5	2	1	14

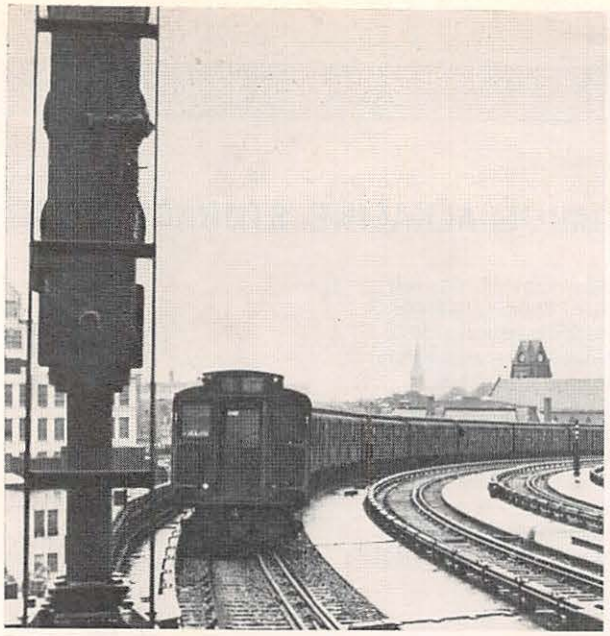
   b. Do you plan to make use of Training Bulletins in the future?

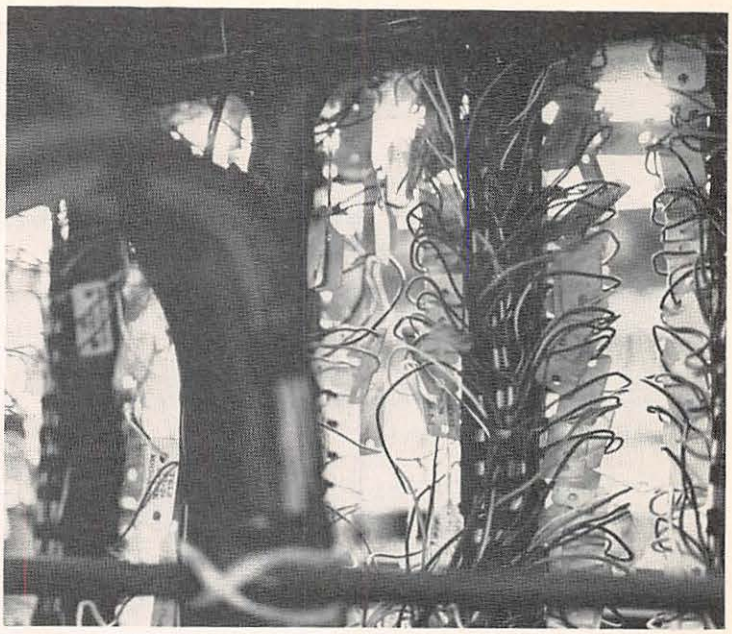
   Yes – 11 No – 4

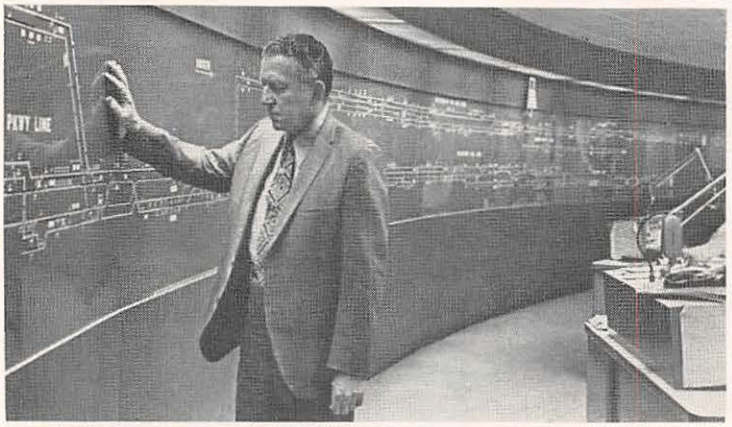
10. Which Bulletins should be prepared next?
    (Listed in order of preference)

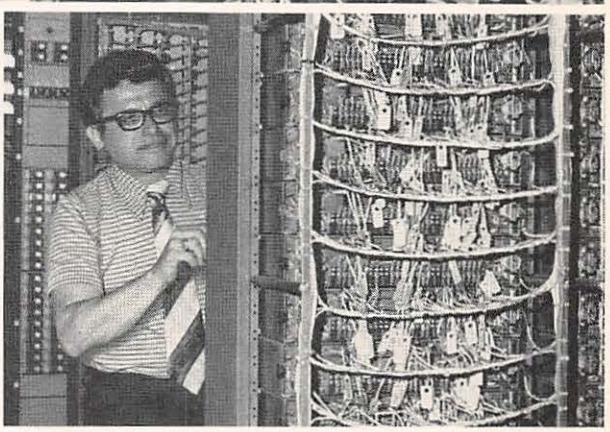
    D-1 – Direct Current Track Circuit.
    E-2 – Highway Crossing Protection—Flashing Light Type.
    F-1 – Automatic Block Signal System.
    G-1 – Voltmeter
    E-4 – Highway Crossing Protection—AFO Track Circuit.
    A-10 – Power Switch Machine.
    D-3 – Direct Current Coded Track Circuit.
    G-2 – Ammeter
    E-3 – Highway Crossing Protection—Gate Type.
    G-4 – Multimeter

	Communications		Comm. or Sigs.	Signals	
	Inside Plant	Outside Plant	Electronics	Conventional Signaling	Solid State Systems
Formal classroom	4	3	2	7	3
Self-teaching material	3	1	3	7	3
Correspondence course	2	1	4	1	—
Formal on-job	5	4	2	3	2









AS YOUR SIGNAL AND CONTROL SYSTEMS GET MORE COMPLEX, THE CHOICE OF WIRE INSULATION GETS SIMPLER.

It's no news that signal, control and communications equipment in railroad and transit systems is becoming increasingly complicated. And that failure in any part of that equipment has become an increasingly serious problem.

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The photographs above show some of the uses of TEFLON in modernized switching towers and communications systems of the New York City subway system. We would like to send you a report on these applications, and test data on TEFLON and TEFZEL as insulations in the complex electrical/electronic equipment of today's railroads and transit systems. Write Du Pont Company, Room 24106, Wilmington, DE 19898.

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1. Title: SECONDARY BATTERY NICKLE-CADMIUM-ALKALINE STORAGE TYPE

2. Definition:

(a) Secondary Battery: A combination of two metals or metalloids immersed in an electrolyte which in itself will not produce electrical energy without first having the metallic portion of the element decomposed by passage of electric current.

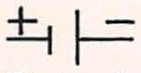
(b) Storage Cell: A secondary cell for storing electrical energy at one time for use at another time.

(c) Charging: The process of putting energy into a battery.

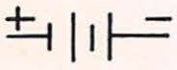
(d) Discharging: The process of taking energy out of a battery.

(e) Electrolyte: The fluid surrounding the elements of the battery

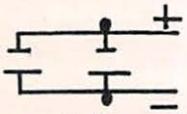
3. Symbol:



Single cell



Two cells in series



Two cells in parallel

4. Description:

The plates of the nickel-cadmium battery are of the pocket type. The active material is contained in steel pockets made from finely perforated nickel plated strips formed into channels. A perforated steel cover strip is crimped into place to form a permanent envelope for the active materials. The pockets are interlocked, cut to length and placed in a steel plate frame for extra strength. The plate groups are insulated and inserted in either steel or high impact resistant plastic containers. The electrolyte is a solution of potassium hydroxide in water. See Figs. 1 and 2.

1 Polystyrene Container
2 Positive Pocket (Nickel Hydrate)
3 Negative Pocket (Cadmium Sponge)
4 "Hairpin" type Plastic Plate Insulator
5 Plastic Edge Insulator
6 Positive Plate
7 Negative Plate
8 Steel Connecting Rod
9 Steel Connecting Nut
10 Steel Spacing Washer
11 Positive Terminal Pole
12 Negative Terminal Pole
13 Plastic Cell Cover (Bonded to Container)
14 Terminal Pole Packing Washer
15 Seal Uut
16 Vent Cap
17 Electrolyte Minimum & Maximum Level Indicators

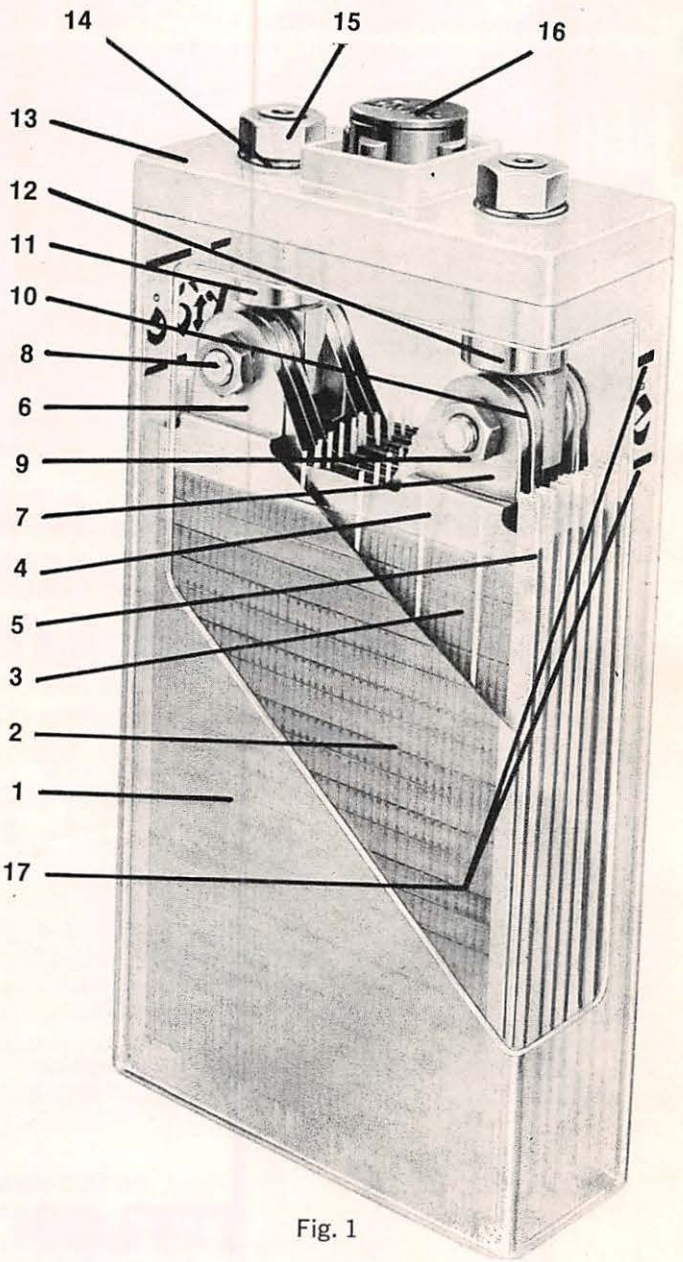


Fig. 1

5. Purpose and Application:

The nickel-cadmium storage battery is used as a dc power source at locations where an ac charging source

Chemical action in a Nickel-Cadmium storage battery.

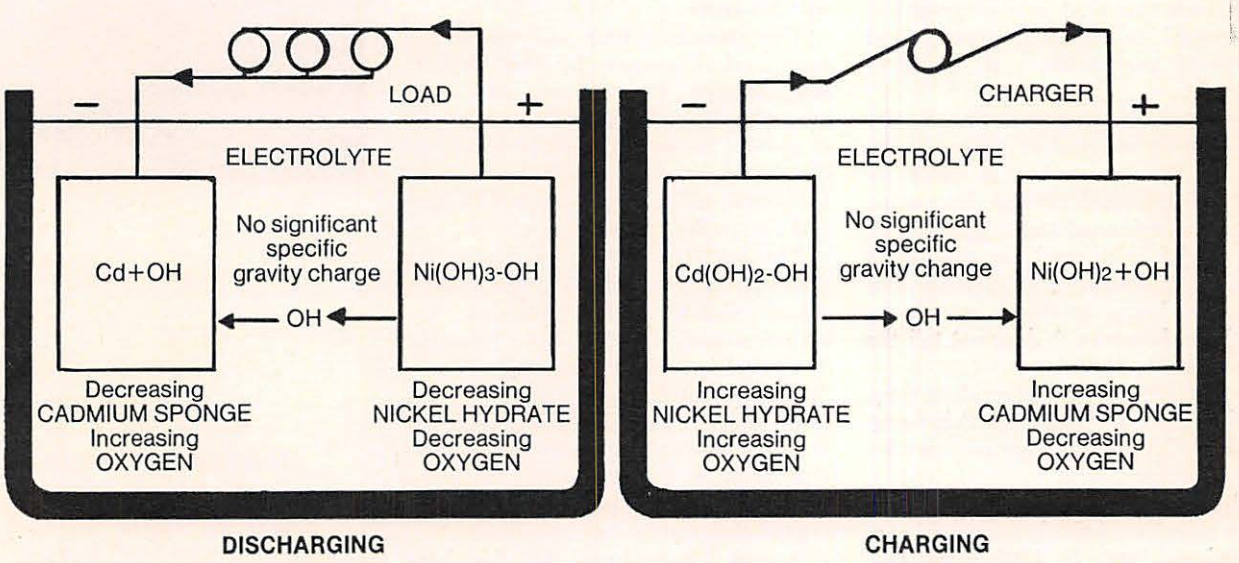


Fig. 2

is available. It can be used for track circuits, signals, highway crossing protection or for any railway signal appliance or circuit that requires direct current.

6. General Information:

Nickel-cadmium battery is especially adaptable where rough handling may be encountered.

One important advantage of the nickel-cadmium battery is that it can be stored almost indefinitely without attention. The rugged construction of the cells contribute substantially to their long life. Thus shedding of active materials from the plates is virtually impossible.

The nominal voltage of a nickel-cadmium cell under load is 1.20 volts. The actual voltage depends on whether the cell is on open circuit, charge or discharge. Open circuit voltage may vary from 1.30 to 1.38 volts. When the cell is connected to an external load, its voltage will fall to a value dependent on discharge rate and state of charge. If the rate is held constant, the voltage decreases until it reaches a point where the cell is considered normally discharged. This is termed "final voltage," and it varies with the rate of discharge. A commonly used final voltage is 1.14 volts per cell.

Some general rules for storage battery installation and maintenance:

(a) Check polarity and connections when installing.

(b) Maintain proper charge.

(c) Maintain proper electrolyte level by adding water but do not overfill.

(d) Keep battery dry and clean.

(e) Avoid flames or sparks around battery since discharged gases might explode.

(f) Keep vent plugs in place and tight.

(g) Check terminal nuts at regular intervals and tighten if necessary.

(h) Keep terminals coated with greese as specified by railroad maintenance instructions.

(i) The electrolyte is alkaline and is injurious to skin and clothing. If contact occurs, wash immediately with water.

(j) It is recommended that all exposed metal surfaces be occasionally wiped with an oily rag or given a light film of oil with a brush to prevent oxidation.

7. Detailed Operation:

The nickel-cadmium battery has a nickel hydrate positive plate, cadmium sponge negative plate and potassium hydroxide electrolyte. When the battery is discharged the positive plate is reduced to a lower oxide and the cadmium negative plate is oxidized. The reaction is mainly an oxygen iron transfer between plates, as in the nickel-iron cell. The specific gravity of a new cell, is 1.160 to 1.190 at 25C (77F) and at the normal solution level. As no constituents of the electrolyte combine with the active material of the plates, the specific gravity does not change appreciably during charge or discharge, and therefore it does not indicate the state of charge or discharge.

Letters

First car retarder?

Braunschweig, Germany

To the Editor:

In the June 1973 edition of RSC the article, "Retarders are key to yards," underscores the vital role of retarders with regard to economic aspects and operational performance of classification yards.

The introductory information to the effect that retarders date back five decades to their invention in 1924 by E. M. Wilcox and George Hannauer, requires supplementation. That statement might hold good for the North American Continent and possibly also for a special retarder design introduced over there; however, it does not tell the whole story.

The retarder, the beam or clasp type, as referred to in the RSC article, originated in Continental Europe, specifically in Germany.

Relevant German patent literature makes mention of the beam retarder as far back as 1891. In 1905 individual, manually operated retarders of this type were constructed and in operation. Granted, these were of a relatively weak-powered design and had no essential significance on further development. Nevertheless, they showed the characteristics of today's retarders, that is, the double beams, parallel with the running rail, which, activated by manual or mechanical control, gripped the side faces of the car wheels thus decelerating their rotation.

The decisive breakthrough was then achieved by the railway engineer, Ernst Frolich of the former German Reichsbahn, who, in 1913 came up with the weight-responsive retarder associated with his name.

This retarder which saw further intensive development by the German firm, August Thyssenhutte AG Duisburg-Hamborn, and was installed in numerous yards, both on the European Continent and abroad, then became the forerunner of beam retarders both here and also in the United States.

The initial prototype yard plus the then up-to-date retarders and automated switch control features, was commissioned in 1925 by the Deutsche Reichsbahn in their Hamm Yard as a "standard mechanized" gravity yard. However, this date by no means represents the date of origin of the first beam type retarder but rather the inauguration of an already advanced, total concept of the modern gravity yard.

August Thyssenhutte AG, has been active in the field of classification yard technique for approximately 60 years and not only has been continuously upgrading Frolich's retarder-constructions, but has also come up with entirely novel and diverse concepts suited for a variety of operational applications.

Herbert Ahlgrimm
Chief Engineer
Siemens AG

Track circuits—another role

(continued from pg. 15)

by the discharge of a capacitor into the track at recurrent intervals, via a thyristor. The resulting track signal is a series of high-intensity impulses and information is transmitted by control of the impulse repetition rate.

Two trainborne antennas are used and the output signal from each antenna is processed and checked for coincidence. The signal is then passed to a series of gating circuits, each comprising two monostable circuits, such that an output will be obtained only if there is the correct interval between successive impulses. Three correctly timed impulses must be received before an output is given and an interlock feature is included so that duplicate output signals are inhibited.

Conclusion

"Recent years have seen many suggestions for novel concepts of sophisticated train control, but all these proposals have one feature in common, namely the provision of a viable track-to-train communication link. The use of the rails for this purpose, by adaptation of the track circuit, offers a system of elegant simplicity since little or no additional track equipment is required. As stated earlier, these systems feature an inherent inability to pass information inadvertently to the wrong train. By virtue of these features, in addition to the inherent properties of track circuits, concepts of train control may be established which are intrinsically fail-safe.

A major restriction on the application of the technique is undoubtedly the restricted information handling ability of track circuits. However, by suitable optimization of the signaling concepts an adequate control may be provided, covering all features which are required for safe operation of trains."

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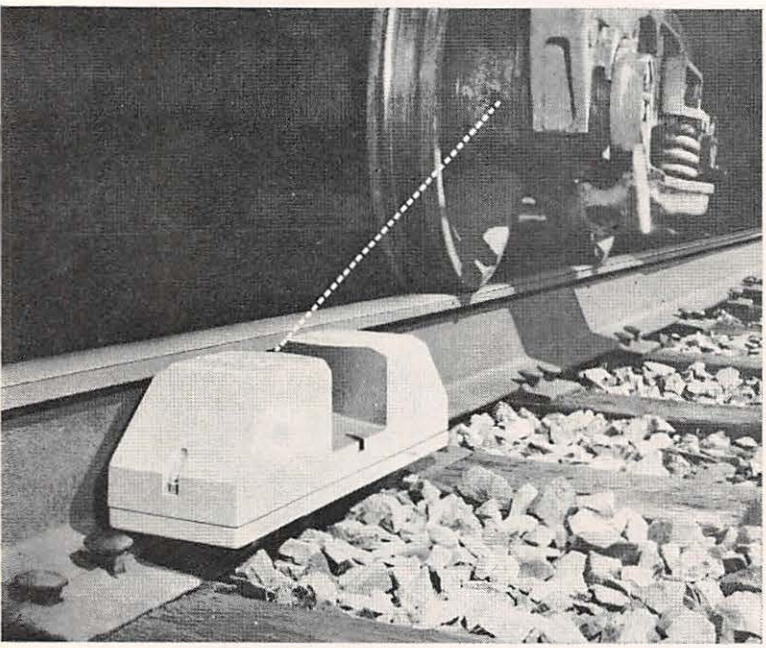

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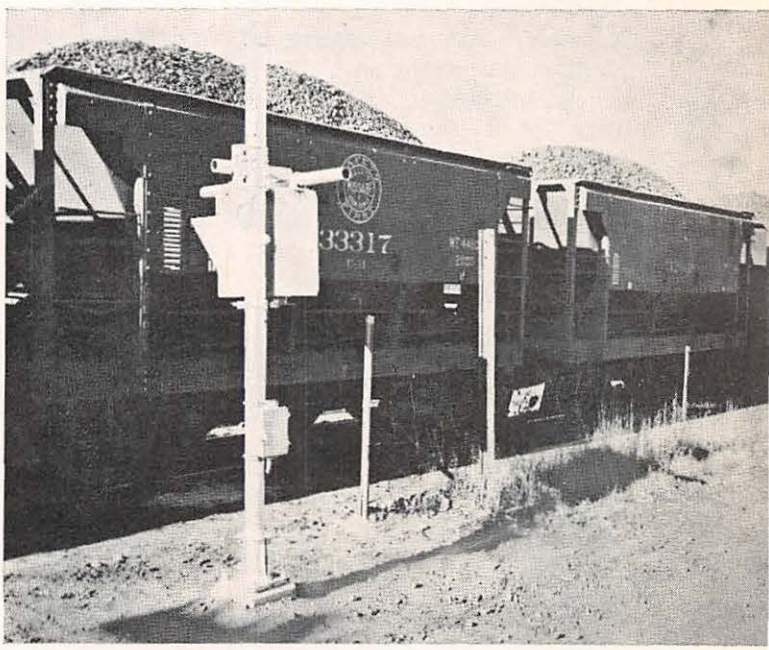

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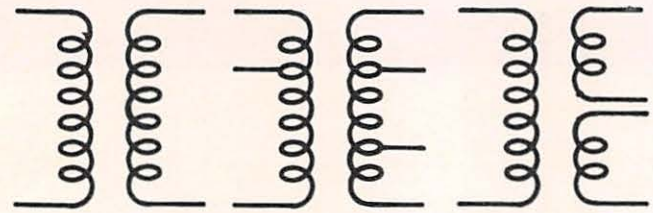
Serving Safety Through Science

1. Title: TRANSFORMER

2. Definition:

Transformer: An inductive device used for changing the ratio of voltage and current in two parts of an alternating current circuit or for insulating one part of a circuit from another.

3. Symbol:



Transformer | Tapped Transformer | Split Secondary Transformer

4. Description:

A simple transformer consists of two coils very close together, electrically insulated from each other. The coil to which ac is applied (source) is called the primary. The coil from which the transformed ac is taken is called the secondary (load). The coils are not physically connected to each other. They are however, magnetically coupled by means of a common iron structure known as the core. The basic construction of a transformer is illustrated in Fig. 1.

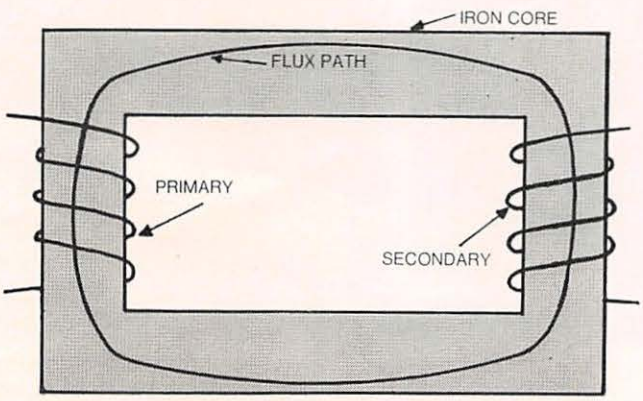
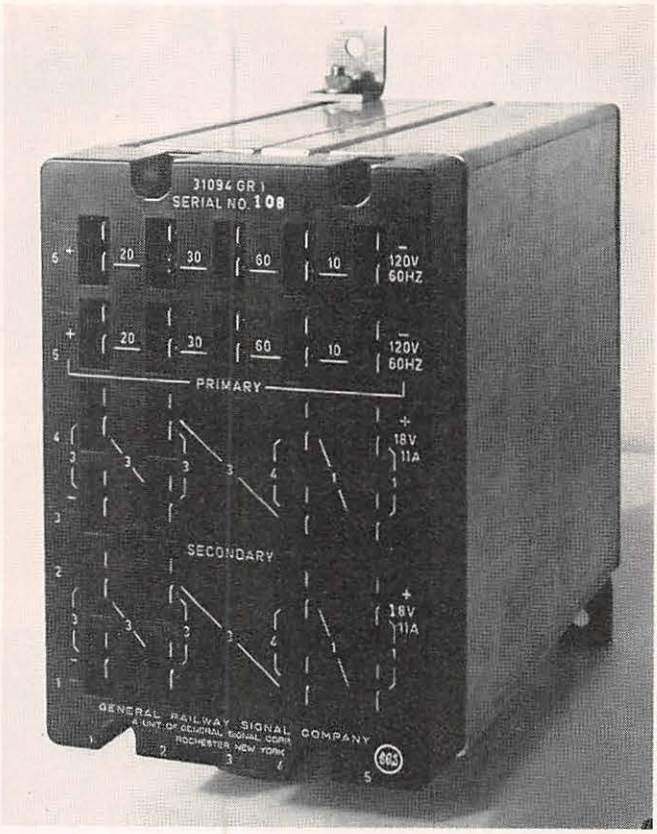


Fig. 1

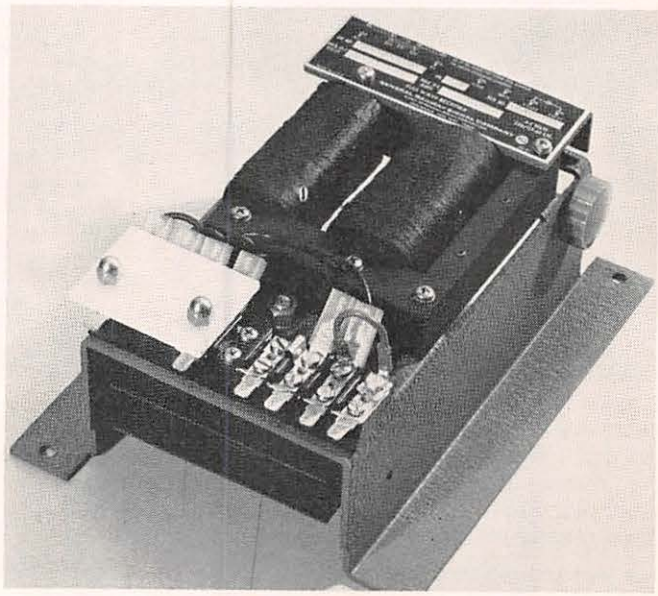
Fig. 2(a) and (b) are examples of transformers in common use in railroad signaling.

Fig. 2(a) shows a tapped transformer which is capable of supplying any whole voltage between 1 and 15 volts ac from the secondary when the primary is connected to either 110 or 220 volts ac. This type is often used to supply signal lamp circuits.

Fig. 2(b) shows a magnetic shunt type transformer—rectifier unit used for charging batteries. The output voltage from the secondary may be precisely adjusted by use of the adjusting knob. (upper right corner of illustration).



(a) Tapped Transformer



(b) Signal Rectifier
(Rectifier stacks removed)

Fig. 2

5. Purpose and Application:

The most common signal application of the transformer is to increase or decrease ac voltage. When the voltage available at the secondary is lower than the voltage applied to the primary it is called a step-down transformer. A transformer that has higher secondary voltage

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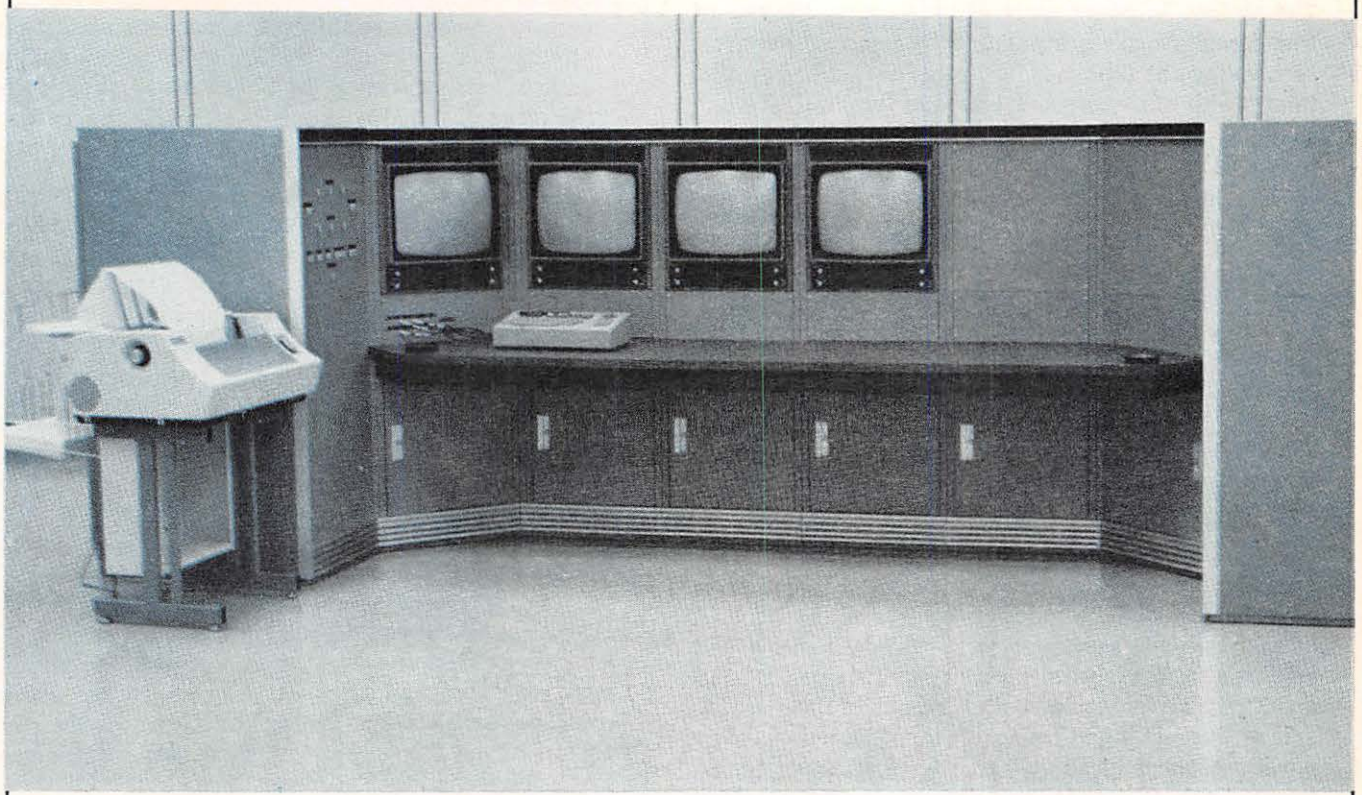

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than primary voltage is called a step-up transformer. The use of step-down transformers in signaling provide real savings in power and material costs.

The savings in power costs occur because the use of transformers makes it possible to transmit relatively high voltage ac (220 volts, 550 volts, etc.) over long distances with minimal power losses in the line. Although the line wires do have low resistance, high current through the wires will result in high power dissipation in the line.

Power in an electrical circuit is the circuit current squared, multiplied by circuit resistance. $P = I^2R$. By considering the formula it may be seen that any reduction in current will significantly reduce the power dissipated. By employing high voltage such as 550 volts ac and step-down transformers at the signal locations it is possible to transfer the energy from the commercial source to the remote signal location with low line currents and therefore low line losses.

The savings in materials occur because only one ac transmission line is used to supply many lower ac voltages required at the signal location. For example, a typical bungalow at a power switch signal location will often require 110 volts ac for bungalow lighting and appliance outlets, 10 volts ac for signal lamps, 30, 13.5 and 3 volts ac for storage battery chargers. If a separate pair of line wires had to be run from the ac source to provide each of these voltages the cost would be extreme. Each of the lower voltages may be obtained through the use of step-down transformers connected to the one high voltage transmission line.

6. General Information:
Transformers are very efficient. They require little maintenance other than to be kept clean and dry. Terminals must be kept tight and clean.

7. Detailed Operation:
The transformer functions on the principle of mutual induction. The term mutual induction refers to the condition in which two circuits are sharing the energy of one of the circuits. It means that energy is transferred from one circuit to another.

The following description is not intended to cover all the theory of self and mutual induction which are involved in transformer action. Instead, the basic operation of transformers is discussed followed by a brief application to two types of signal transformers.

First, induction only occurs when the current is changing. Two examples of changing currents are alternating current (ac) or pulsating direct current. Induction does not occur with steady direct current. Steady direct current should not be applied to a transformer winding because the resistance to dc is quite low and the transformer could be damaged by the resulting high current flow.

NOTE (1) When a changing current such as ac is passed through a coiled conductor a changing magnetic field of flux is produced about and within the coil. If a magnetic material core is placed within the coil so that the flux lines cut across the core the core becomes magnetized. Since the magnetizing force is produced by ac which is constantly rising and falling and changing direction the strength and direction of the magnetism in the core is in step with the ac. This occurs in a transformer primary.

(2) When a conductor is placed within a changing field of magnetic flux so that the flux lines cut across the conductor a voltage will be produced across the conductor. If the conductor is coiled so that many conductors are cut by the moving magnetic field a higher voltage will exist and will be in proportion to the number of conductors cut. This occurs in the transformer secondary.

When ac is applied to the primary winding of the transformer and the secondary winding is connected to a load there is a transfer of energy from primary to secondary. The ac entering the primary is rising, falling and changing in direction with the frequency (60 HZ). This action produces a magnetic field of flux in the core which is building up, collapsing and changing direction at the same rate as the ac source. The core is common to both primary and secondary therefore the changing magnetic flux field is cutting across the conductors of the secondary windings and an electric current is induced in the secondary.

As mentioned in the Note the more conductors that are cut by the magnetic flux the higher the voltage. In transformers the relationship between primary turns of wire to secondary turns determines if it is a step-up or step-down transformer. If the number of primary and secondary turns are equal, the voltage in equals the voltage out.

In Fig. 3(a) the secondary has ten times more turns than the primary. The 110 volts ac at the primary is transformed to 1100 volts at the secondary (step-up transformer).

In Fig. 3(b) the secondary has ten times fewer turns than the primary. The 110 volts ac is transformed to 11 volts at the secondary (step-down transformer).

In Fig. 3(c) the primary to secondary turn ratio is equal. The voltage out equals the voltage in. This transformer is referred to as an isolating or insulating transformer and is sometimes used in signaling where an ac signal is superimposed on a dc line circuit network. The transformer will pass the ac but will block the dc from flowing in parts of the circuit where it is not wanted.

Transformers are also used to eliminate shock hazard by isolating the grounded source from the equipment circuits.

It would appear that a step-up transformer gives something for nothing. This is not true. Although a step-up provides more voltage at the secondary the current ca-

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75D1, 10,700-11,700 MHz, 1800 channels or TV
75E1, 12,200-13,250 MHz, 1200 channels or TV
75G1, 3700-4200 MHz, 1200 channels or TV
78A2, 5925-6425 MHz, 1200 channels or TV
78B2, 6425-7125 MHz, 1200 channels or TV
78C2, 7125-8400 MHz, 1200 channels or TV
78D2, 10,700-11,700 MHz, 1200 channels or TV
78E2, 12,200-13,250 MHz, 1200 channels or TV
78F2, 1700-2300 MHz, 600 channels or TV

Microwave Radio Subsystems

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52A Order Wire Assembly
53C Order Wire and Tone Signaling
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47A/N2 Cable Carrier System for 4-12 channels on two cable pairs
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X Carrier System for 4-20 channels on two cable pairs

PCM Cable Carrier Systems

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9002A D2 and D3 PCM Channel Bank for 1-24 channels on two cable pairs
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82B Cable Carrier System for 1-6 channels on a single cable or wire pair
83A Single-Channel Station Carrier System
84A Single-Channel Station Carrier System
821B Cable Carrier Station Terminal combining four six-channel 82B systems
910A PCM Subscriber Carrier System for 1-48 channels on four cable pairs
XU Subscriber System for 4-20 channels on two cable or wire pairs
XL Subscriber System for 2-8 channels on a single cable or wire pair

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948A Repeater and Order Wire Assembly

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25D 75-200 b/s Voiceband Telegraph Multiplex System
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26C 40.8 kb/s Single-Channel Wideband Data Set
26D 4800 b/s Single-Channel Voiceband Data Set
26U 1200 b/s Single-Channel Data Set
261A 2400 b/s Single-Channel Data Set
262A 4800 b/s Single-Channel Data Set
960B Journal Data Transmission System
9003A PCM Data Terminal for 2-8 channels at speeds of 50,000-250,000 b/s
9005A Single-Channel PCM Data Terminal at speeds of 50,000-250,000 b/s

Auxiliary Data Equipment

970A Wideband Modulator
971B Adjustable Equalizer
973A Wideband Modulator
5249A Speech-Plus-Data Panel

Supervisory and Control Systems

51F Alarm System
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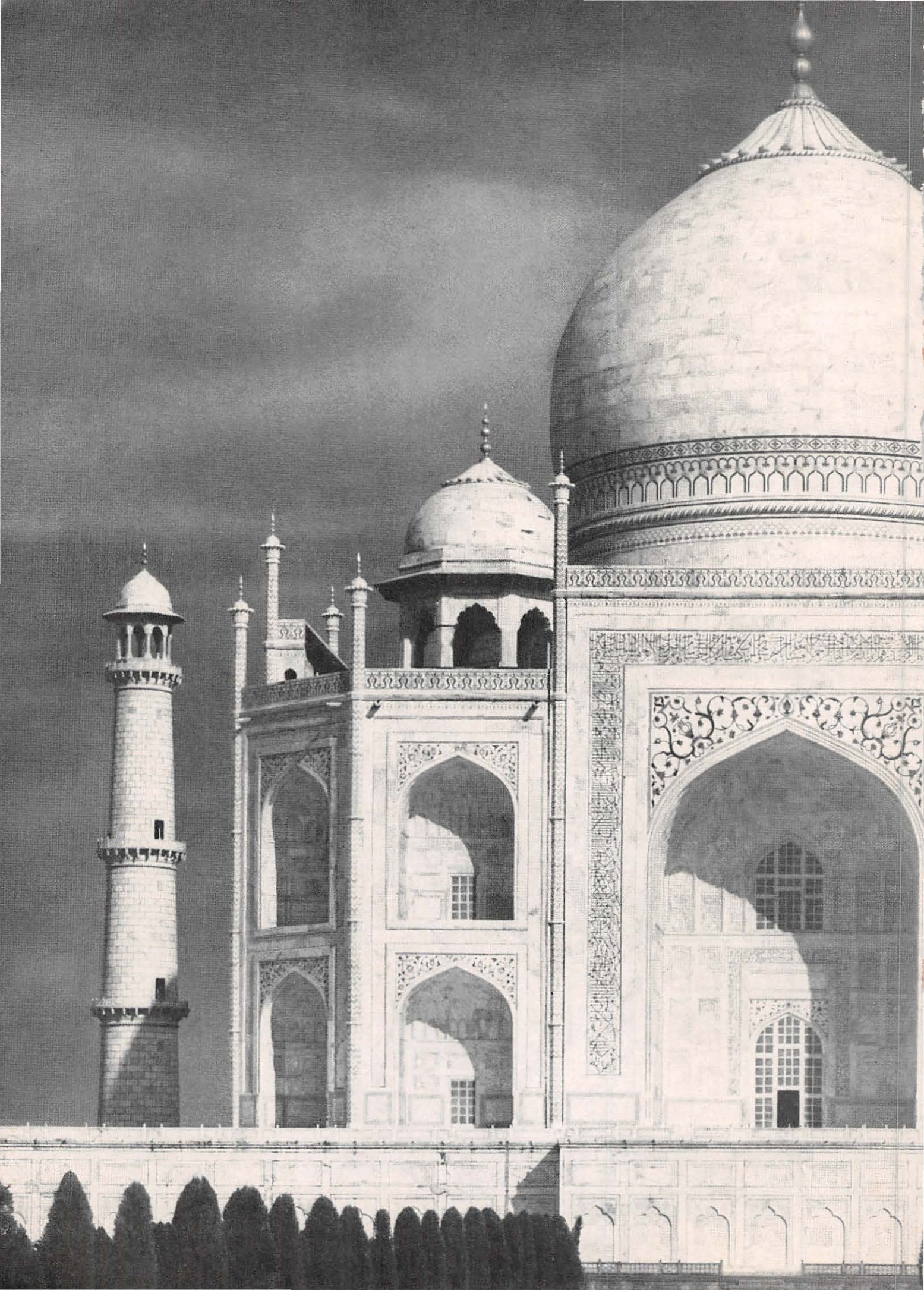

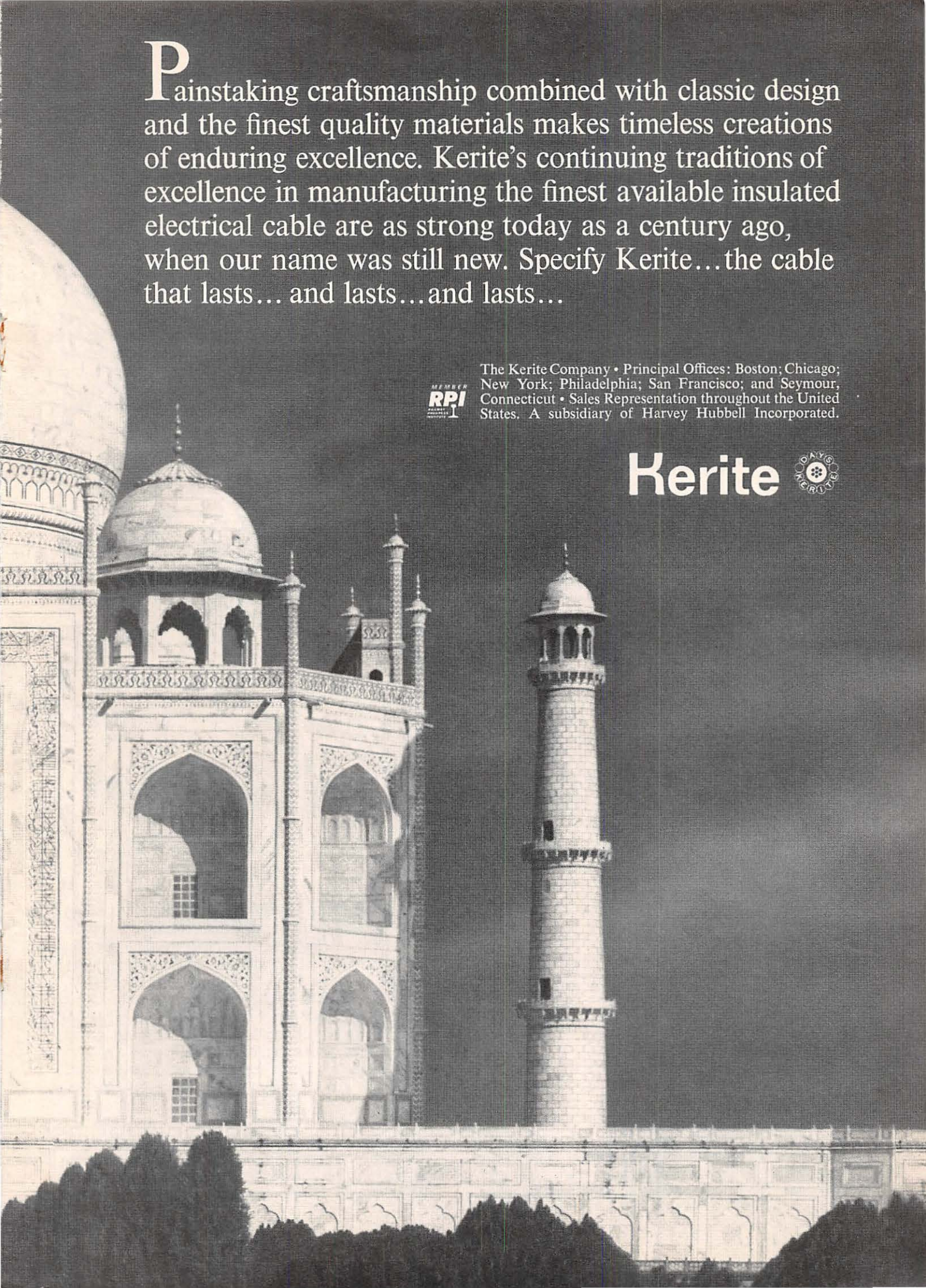

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pacity is down. Power is the important consideration since this is the measurement of work. Because a transformer is such an efficient device the power in almost equals the power out. Therefore, if a 0.100 ampere load was connected to the secondary (Fig. 3(a)) the power consumed would equal 110 watts since P (power) = E (voltage) x I (current) = 1100 x 0.100 = 110 watts.

If the secondary load is consuming 110 watts then primary must also be 110 watts. Entering the known values into the formula P = EI the current in the primary is found to be 1 ampere.

$$P = EI \text{ or } 110 = 110 \times I$$

$$\text{or, } I = \frac{110}{110} = 1 \text{ ampere.}$$

In the case of the step-down transformer in Fig. 3(b) a 10 amp. load on the secondary would result in a 1 amp. current in the primary.

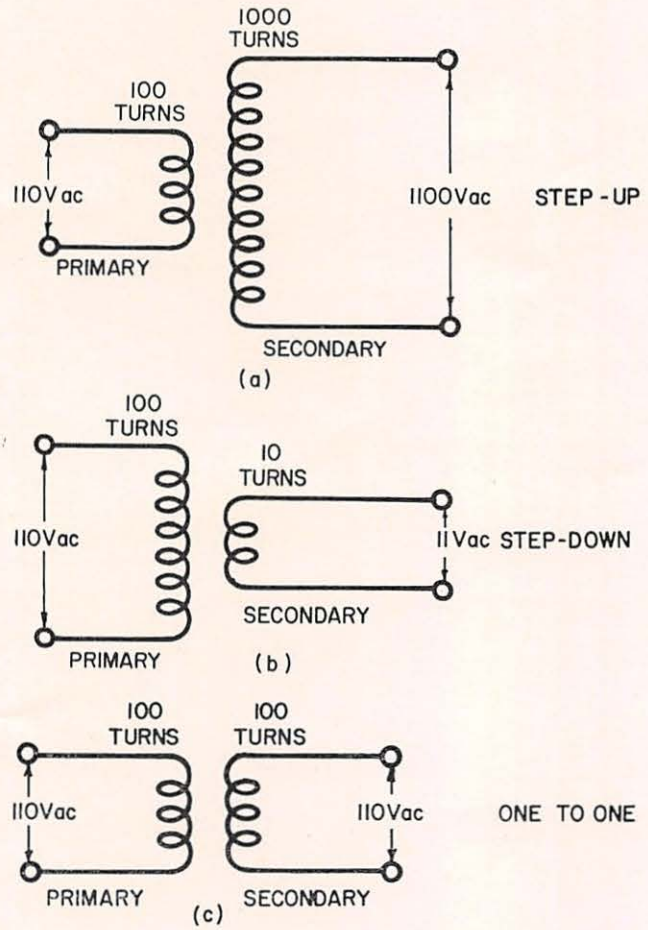

Fig. 3

This is why use of high voltages and step-down transformers in transmission circuits reduces line losses. Even though the signal load requires high current at low voltage the current present in the transmission line is quite low and depends on the step-down ratio. If a 10 volt load is being supplied by a 550 volt transmission line and step-down transformers the line current is 55 times less than the load current.

8. Signal Application:

Fig. 4 schematically represents a tapped transformer. By connecting taps to the secondary at various points the primary to secondary turns ratio may be selected to suit the need.

An ac voltmeter reading taken across the entire secondary would show 15 volts. A reading between the bottom two taps would indicate 1 volt. The position of the tap is selected so that any whole voltage between 1 and 15 is available. This type of transformer is used to light signal lamps and supply other ac equipment such as power off relays.

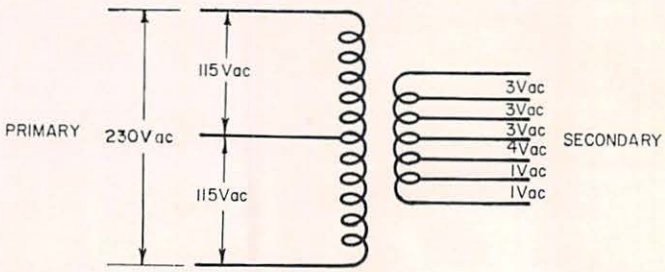

Fig. 4

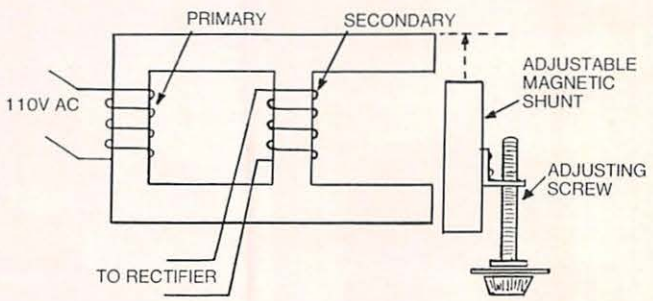

Fig. 5

Fig. 5 illustrates a transformer of the magnetic shunt type. The output voltage may be adjusted by moving the magnetic shunt. Suppose the primary to secondary turn ratio were such that 110 volts ac applied to the primary resulted in a maximum of 3 volts ac at the secondary. The 3 volts would be present when the adjustable shunt is in the position where the largest air gap exists between the shunt bar and the core structure. Note that the shunt provides an additional path for the magnetic flux developed in the primary. This path diverts some of the magnetic flux away from the secondary core and is not available to develop voltage in the secondary. By use of the adjusting screw the shunt may be moved until almost all the magnetism takes the shunt path. This feature provides a means to control the secondary voltage very precisely to obtain the voltage required for fine calibration of the battery charge rate.

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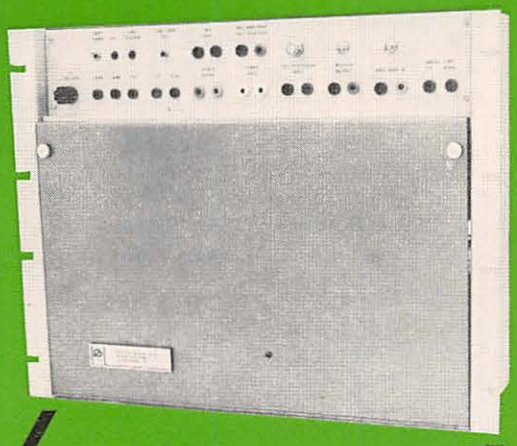

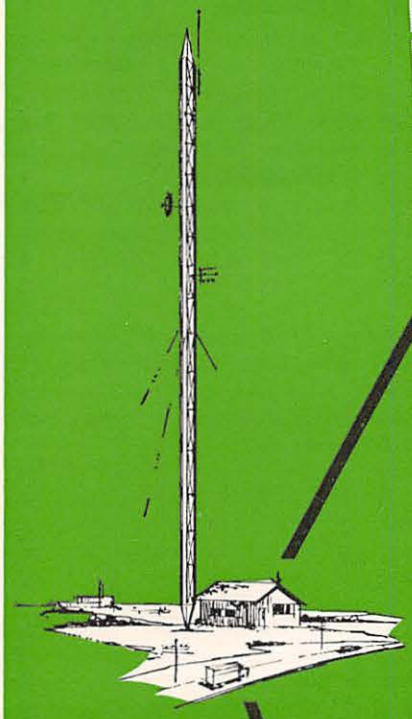

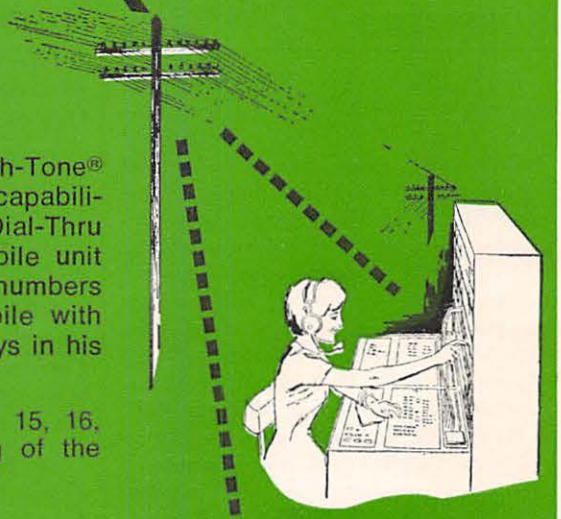

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People

ELGIN, JOLIET & EASTERN—Kenneth P. Elliott appointed signal design testing supervisor—system, Gary, Ind.

LOUISVILLE & NASHVILLE—Donald E. Boatright appointed supervisor signals, Louisville.

NORFOLK & WESTERN.—John D. Muskopf promoted to assistant engineer, S&C, St. Louis, succeeding the late **J. B. Morris. Charles B. Gordon** advanced to assistant supervisor signals and communications, Portsmouth.

William A. Leighton named supervisor, S&C, Bluefield, W.Va., succeeding **Leslie A. Gill**, transferred to Roanoke. **Jack D. Daniel** appointed assistant supervisor, S&C, Princeton, W.Va., succeeding Mr. Leighton. **Irvin H. Wood**, assistant supervisor, S&C, Portsmouth, transferred to Williamson, W.Va., to succeed Mr. Daniel.

SUPPLIERS

B. R. Merta has been appointed manager-Central Region, **Safetran Systems Corp.**, Louisville, Ky. **Ronald Rudnicki** has been named sales and service engineer-Northern Region, Minneapolis. **J. I. Matson** has been appointed sales engineer-communications, Chicago. Mr. Merta was formerly Eastern Region manager, **Edison Battery Co.**; Mr. Rudnicki was with the Signal Department, **Soo Line**; and Mr. Matson was in the Signal & Communications Department, **Chicago Belt.**

Ronald G. Robbins, sales & service engineer for Safetran at Minneapolis, appointed manager-Southeastern Region, Conyers, Ga. **Robert F. Thompson** transferred from Louisville to sales and service engineer, Conyers.

The following field service representatives promoted to sales and service engineers: **S. L. Fischer**, Central Region, Chicago; **P. L. Buttram**, South Central Region, Grain Valley, Mo.; and **J. R. Batema**, Western Region, Cucamonga, Calif.

Claude N. Romans, manager of product assurance, **GTE Lenkurt, Inc.**, San Carlos, Calif., has been appointed chief engineer, PCM and data development, replacing **William G. Chaney**, promoted to chief engineer of the Albuquerque, N.M., manufacturing facility. **L. Deane Crawforth**, manager of digital systems engineering, succeeds Mr. Romans with the title of manager of quality assurance and instrumentation.

M. R. Electronics & Equipment Co., Inc., Birmingham, Ala., has been named an authorized distributor by the **Adams & Westlake Co.**, Elkhart, Ind., manufacturer of mercury-wetted and mercury displacement relays.

Robert H. Glines has been appointed manager of industrial sales, **General Railway Signal Co.**, Rochester, N.Y. Mr. Glines was formerly sales engineer, Chicago.

NIFE Incorporated, Copiague, N.Y., has appointed two new manufacturers' representative firms to handle NIFE sales. The firms are **G. R. Peters**, Detroit and **Lynn Elliott/New Orleans.**

Alan S. Kushner has been appointed advertising product manager, **General Cable Corp.**, Greenwich, Conn., reporting to **John Cavanaugh**, manager of advertising.

Daniel E. Robinson, manager, wiring systems and instrumentation, research center, Union, N.J., has been appointed assistant director of research.

John W. Eberenz has been appointed sales representative-Pittsburgh district, **Okonite Co.**

Alfred Y. Elk, sales engineer, Northeast regional office, **Data General Corp.**, Southboro, Mass., has been promoted to district sales manager for New York State, at Rochester, N.Y.

John W. Schoff has been appointed sales engineer, **Lynch Communication Systems Inc.**, at Batavia, Ohio. Mr. Schoff has had 17 years of experience in the telecommunications industry.

Art Baldensperger has been appointed marketing vice president, **Antenna Specialists Co.**, Cleveland. He was formerly associated with **Motorola** as marketing manager, HEP program.

NIFE Incorporated, Copiague, N.Y., has appointed five sales managers: **Joseph Andrechyn, Douglas Fortner, Ronald Frates, John L. Ripley**, and **Carl Baranishyn.**

L. E. Savage, product manager/systems, **Northeast Electronics**, Concord, N.H., has been appointed director of marketing. **Robert S. Kunkel**, national sales manager, has been named director of sales.

Robert L. Schrodetzki, acting manager of sales, **Joslyn Electronic Systems**, Goleta, Calif., has been appointed manager, sales department.

Jack R. Meyer has joined **Rohr Industries, Inc.**, as manager, Washington, D.C., office, Rail Transit Division.

Alan M. Smith, general manager,

B. R. Merta
Safetran

Ronald Rudnicki
Safetran

Electronic Systems Division, **Joslyn Manufacturing & Supply Co.**, Goleta, Calif., has been named group director, operations analysis, Industrial Products. **Alwyn A. deSouza**, engineering manager of the division, succeeds Mr. Smith.

Edwin H. Arnaudin, Jr., manager of production, **Copperweld Bimetallics Division**, has been promoted to works manager, with headquarters as before at Glassport, Pa.

Ronald A. Kral, senior design engineer, **Secode Electronics**, Dallas, has been promoted to engineering manager.

Glen E. Teason has been named as a common carrier market consultant for **Secode Electronics** in the western half of the United States. Mr. Teason was formerly with G.T.E. Automatic Electric, Inc. in Dallas.

Phillip J. Haskell has been appointed manager, communications products manufacturing, **RCA Corp.** Meadow Lands, Pa. facility.

Hugh O. Coleman, Jr., has been appointed sales representative, Los Angeles district, **Okonite Co.** He was formerly application engineer, Watkins Johnson. **John M. Herbert** has been appointed sales representative-Charlotte district. He was formerly development engineer, Western Electric.

Donald E. Stark has been appointed senior consultant, **Union Switch & Signal Division, WABCO.** Mr. Stark will be responsible for technology relating to control systems applicable to both electrified and non-electrified railroads. He will report to **D. D. Huffman**, vice president-engineering, Swissvale.

J. R. Rowell has been appointed sales engineer, **Union Switch & Signal Division**, Chicago, with responsibility for the sale of radio equipment. Mr. Rowell was formerly with the **Rock Island.**

Problems/ Solutions

Problem:

How can solid state equipment be protected from high level radio frequency radiation?

Solution:

Signal or communications equipment causing disturbance to surrounding sensitive equipment may have to be removed from the operating site for maintenance.

As stated in the problem (RSC, June '74, pg. 24), sensitive equipment is usually protected by outer cases and RF gaskets. Likewise, equipment which produces unwanted interference is usually shielded by various means to prevent the radiation from leaving the enclosure. If equipment producing this high level of radiation must have its protective covers removed for maintenance perhaps it may be removed entirely from its normal operating site to a completely shielded area or room. The equipment can be replaced by a plug-in spare so as not to disrupt service.

Similarly, an entire room or area of sensitive equipment might be shielded against outside interference, and prevented from emitting interference itself. The entire room or area may be caged in by a bronze or copper screening which is adequately grounded (it could be built into the ceiling and walls to prove less unsightly).

M. Peacock
King of Prussia, Pa.

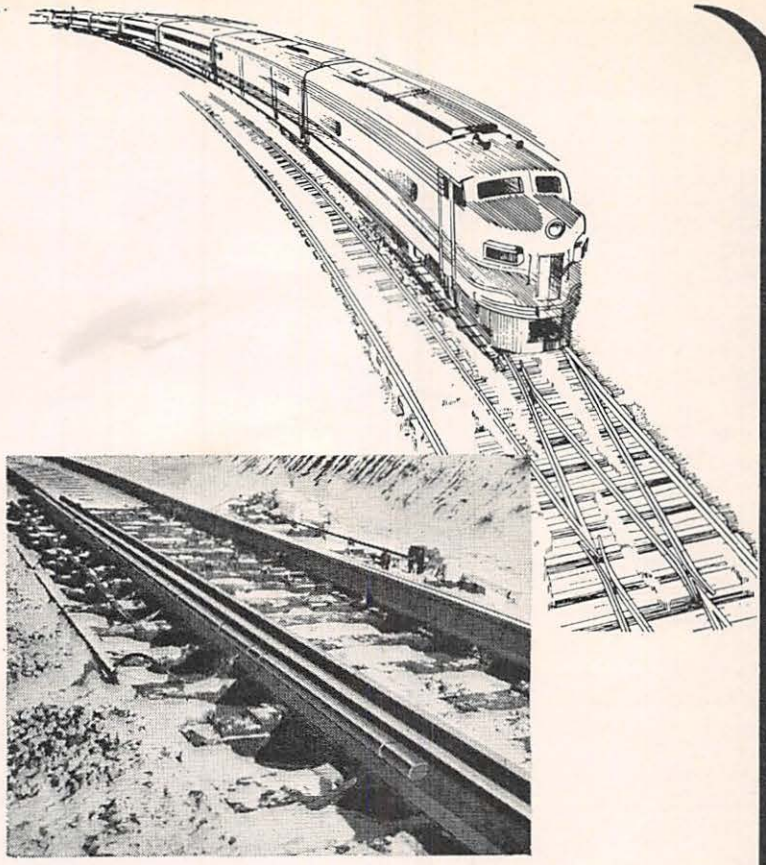
Question:

To minimize battering and damage, a suggestion was recently made by an employee and accepted on the SCL, to cut new insulated joint end posts one-quarter inch shorter where they are to be used between old, worn rails. What is your practice in this respect?

M. Peacock
King of Prussia, Pa.

Problem:

Mechanized tie tamping equipment often damages or knocks off bootlegs and signal wire. What can be done to minimize headaches of the signal maintainers in this connection?



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Nationwide network speeds data

An orderly blending of data processing and telecommunications has been put to work to speed the information flow vital to the marketing, management and maintenance of Amtrak. Priority One, of course, has been to attract customers, and improve passenger service and reservations.

"We are now truly operational," says Amtrak's information systems director Robert J. Dooley, whose L'Enfant Plaza office is only yards away from the computerized management information center in Washington D.C. Working closely with the Bell System and two computer firms, Dooley has accomplished a blending of data processing and telecommunications designed to keep track of both trains and their passengers.

"When we first began in 1971," Dooley says, "many railroads were selling Amtrak tickets. The reservations centers were then manned by agents using revolving turrets that displayed railroad car diagrams. They would make reservations manually by entering names on the printed seats on those diagrams."

Today, Amtrak has been handling an average of 75,000 customer calls in a single day, requiring some 400,000 interactions between the computer and five Central Reservations Offices (New York, Los Angeles, Jacksonville and Bensalem, Pa.). These customer calls could be doubled with the existing system, says Dooley, and "we hope it gets to that."

Amtrak, with about 250 daily trains operating around the U.S., designed its Automated Reservations and Ticketing System (ARTS) to serve the public. The result is a complete management information system.

The heart of ARTS is a Control Data 3500 computer at Amtrak's Washington headquarters, connected to some 1,200 cathode ray tubes in the five major reservations offices and in another 120 ticket-selling locations.

These connections are completed primarily with Bell System Dataphone 2400 data sets, at a speed of 2,400 bits per second. These interfaces permit instantaneous communications between all reservation agents and the main computer in Washington.

The 1,200 agents, on the other hand, are reached by callers through another piece of Bell System equipment, an Automatic Call Distributor (ACD). Incoming calls are, in effect, placed in line as they come in until an agent is available. The object is to keep the waiting time to a minimum of no longer than 13 seconds, a goal which the New York Reservations Center at Penn Station, for example, achieves almost 99% of the time.

The Bell System's 3A ACD in operation at Penn Station displays rows of white lights to indicate that calls are

Amtrak's information systems director Robert J. Dooley has worked closely with Bell System and two computer firms to accomplish a blending of data processing and telecommunications.

The Bensalem Pa. CRO (Central Reservation Office), which covers the East Coast from Maine to Virginia with the exception of New York City, has been in operation since April 1973. Reservation agents at Bensalem make use of 173 CRT display terminals for data exchange with the main computer.

flow at Amtrak

coming into the center. If a reservations agent is free, the white light goes out and a red light on the next panel goes on, indicating that the call has been answered. A blinking green light indicates that a reservations agent has completed the call, but is completing necessary after hang-up work to ticket the passenger. When the agent is ready to accept further customer inquiries, a switch is activated on the telephone and the solid green light returns on the ACD display. Flashing green and red lights indicate that the caller has been placed on hold.

ARTS is accessible to Amtrak reservations agents from all 48 continental states toll-free, 24 hours a day through 530 inward-WATS (Wide Area Telephone Service) lines. (153 WATS lines into Bensalem, 136 into Los Angeles, 66 into New York, 60 into Jacksonville and 115 into Chicago.) ARTS is used not only for reservations but for transmission of management information vital to the smooth operation of the passenger rail system.

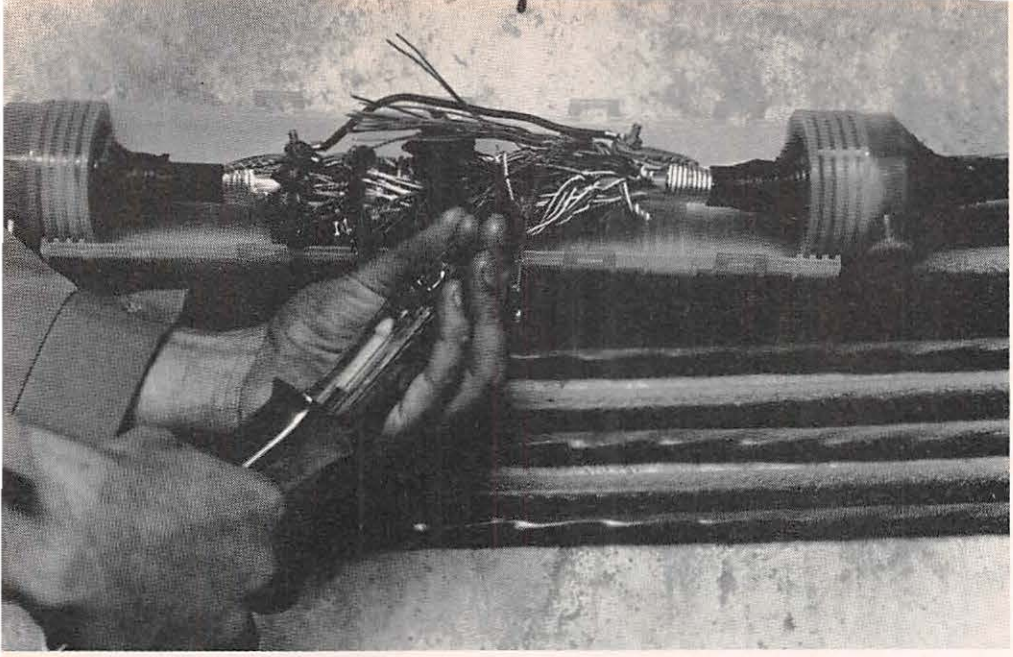
ARTS provides on-time performance reports of each of its 250 daily trains rates and special package prices, station hours of operation, automatic ticketing, even descriptions of accommodations on specific trains.

As if this hardware and software package weren't enough, monitoring the entire operation is another computer, which is more of a management tool than an operational aid. Amtrak's STAR system keeps tabs on all Central Reservations Center operations. Regular printouts tell reservations office managers the number of calls made to Amtrak, how long they took to get through, number of completed and incompleted calls, length of conversations, and other information important to management decisions that affect orderly and efficient operation of a center.

Unlike an airplane, says Dooley, who was formerly with Pan American World Airways and before that spent 22 years with AT&T, "an Amtrak train offers four times as many classes of seats, makes over 11 times as many stops and has to keep an eye on all its 250 trains without an FAA to help out. In terms of bits of information," he continues, "Amtrak must have at its fingertips four to five times as much information as an airline needs."

Far from being satisfied that the system is operational, Dooley's team is doing other things. They have an arrangement with a car rental company with an eye toward offering complete transportation packages. In addition, Amtrak's president, Roger Lewis, recently signed an interline agreement with Greyhound which will, in effect, allow Amtrak customers rail-bus connecting service.

"We also plan to put a communication device on every train for both internal company communications and passenger service and entertainment," says Dooley.



A crimping tool containing a cartridge of butt connectors requires the operator to go to full pressure before the tool is released.

WMATA goes with 3M splicing system for cable connections

The original specifications for signal and control cables in the new Washington, D.C., Metro transit system called for the use of conventional terminal connections at all cable ends with no splices allowed. However, the Washington Metropolitan Area Transit Authority (WMATA) and Metro Gibbs and Hill, Inc. of New York changed to a communications splicing system after studying data presented by Motorola Corp., the communications system equipment subcontractor, and Fischbach & Moore, Inc. and L. K. Comstock & Co., a joint venture responsible for the installation of the Metro's communications and train control systems.

The primary advantage stressed in the change recommendation was the improved connection integrity of the new type of splice over the terminal connection approach. The recommendation pointed out these negative aspects of terminal connections that would be overcome by the splice: loosening of terminal nuts due to vibration; corroding of terminals caused by condensation and contaminated atmospheres; wire fatigue at clamp points from vibration; inability to keep wire lay close to that of the original cable; and mounting limitations of terminal junction boxes.

Terminals were originally specified because of historical precedent—they have been used on all train control and similar cable installations up to now. Previously proposed splicing systems were considered inadequate, and it was not until the development of a new system by 3M Company that splice-type cable connections became feasible.

WMATA first approved the 3M splice for use with communications cables only. Here, the wires were delicate and prone to failure at the terminal connections—with the 3M splice, vibration and atmospheric problems were virtually eliminated. "Once they were convinced of the advantages of using splices for the communications cables, it allowed us to continue our efforts toward an approval for splicing train control cable also," according to Tom Trovato, project engineer with Fischbach & Moore & L. K. Comstock.

With the new procedure, splices are made wherever the cable ends fall: on the wall in tunnel runs, in cable trough on aerial structures or in manholes of duct banks at grade. The advantage of this flexibility is particularly evident on the cable trough and duct bank connections, Trovato said. Eliminated is the need to mount a junction box at some location remote from the cable

(continued on pg. 40)

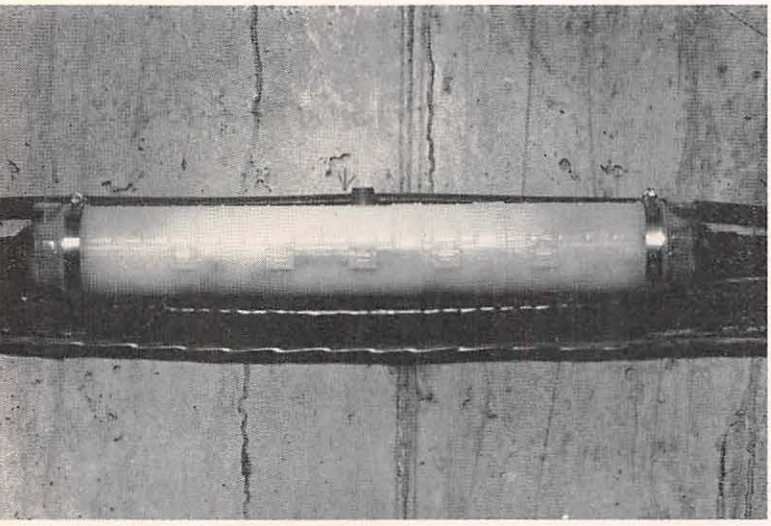


Fig. 1—A communications cable splice is housed in a 3M reenterable closure and supported along a tunnel wall at Washington Metro.

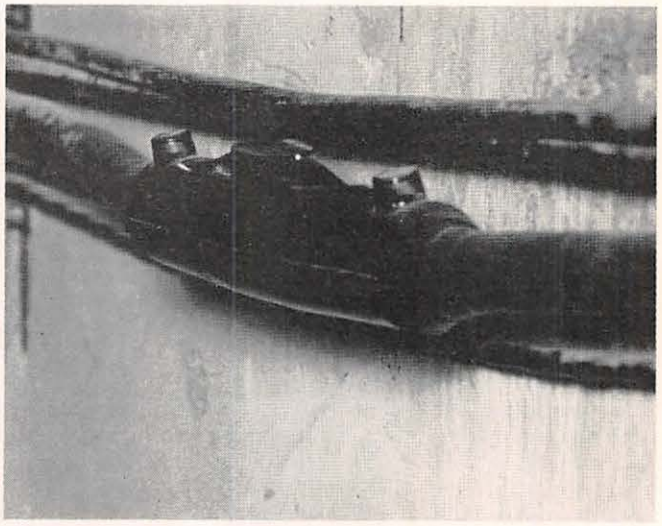
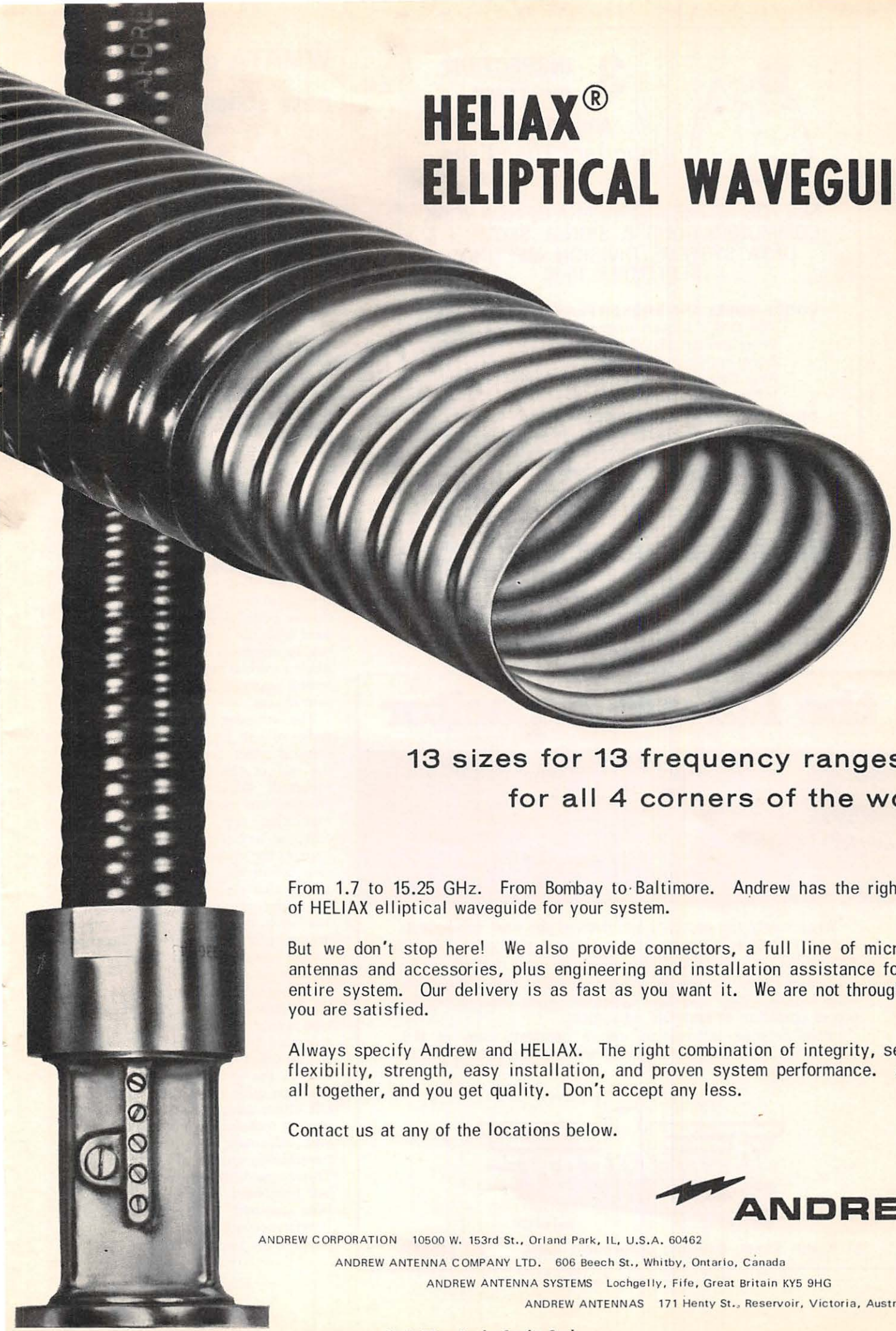


Fig. 2—A train control splice at Washington Metro uses a permanent closure which is cemented together and filled with epoxy upon assembly.



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Circle 21 on Reader Service Card.

WMATA goes with new splice system

and then route each cable end to that location.

Two types of 3M closures are being used at the Washington Metro installation: "reenterable" for the communications cable and "permanent" for the train control cable. The reenterable type was chosen for the communications cable to permit service work on the splices should this ever be required at a later date.

The differences between the two closures are shown in Figures 1 and 2. The reenterable closure (Figure 1) has three main parts: a main body in the center and two ends. Each part is split in two halves for assembly around the cable and splice area. The ends are held securely in place by hose clamps and the body has built-in latches. The permanent closure (Figure 2) is one self-contained unit split in two halves. At assembly, the two halves are cemented together.

After assembly, both types of closures are filled with an encapsulating compound that is injected through the closure ports. A jelly-like compound is used with the reenterable closure that can be removed from the splice when service work is required. A permanent setting epoxy is used with the permanent closure.

The crimping tool contains a cartridge of butt connectors. The two unstripped wires are merely inserted in the end of the tool and the handle squeezed. Wire stripping, connector crimping and ejection of the completed connection are all automatic. The crimping tool is the ratchet type that requires the operator to go to full pressure before the tool is released. This assures that every connector receives a full crimp, eliminating human error. A window in the connector permits visual inspection of the completed connection, further assuring uniform connections for all wires.

The communications cable used at Washington Metro is the "T-Screen" type where the transmitting wires are separated from the receiving wires by an insulated divider (the T-Screen). One of the primary reasons for using this type cable is to obtain good crosstalk attenuation. Here is where the 3M splicing technique offers another important advantage by maintaining the transmission quality of the basic cable, Trovato said. If terminal connections had been used, the signals would have been exposed to considerably more interference where the wires are exposed in the junction boxes.

50 YEARS AGO IN

Railway Signaling

Vol. 17 SEPTEMBER, 1924 No. 9

On May 14, 1924, the Reading Company placed in service for the use of the traveling public to Atlantic City, a modern ferry terminal at Camden, N.J., as well as an electro-pneumatic interlocking plant, for controlling the movement of trains to and from the 14 station tracks at the new terminal.

° ° °

To the Editor:

I have read with considerable interest the comment of one of your readers in the August issue, with regard to illuminating railroad crossing signs. It seems to me that this comment is well taken. While driving a closed car on to a railroad crossing at night, even though there was a crossing sign and ringing bell, I could not hear the bell and if the head lights are trained properly to comply with the anti-glare laws, the beam is not high enough to illuminate the crossing signs.

Primary batteries and incandescent lamps have been developed to the point where it is entirely practical to have a flashing sign or warning at railroad crossings at a relatively low cost. An automatic sun valve is also available, which will cut off the current during the day. Battery signals of this type can be installed, which will operate without attention for periods of six months at a time.

L. C. Porter

° ° °

The Pennsylvania Supreme Court states the rule of law in that state to be that "where one about to drive a vehicle across a railroad at a crossing stops before entering upon the tracks and finds his view obstructed, he must alight and go forward to a point which affords a better outlook. Merely stopping where approaching danger is not noticeable is not an observance of his duty.

° ° °

At the fifteenth meeting of the Signal Section of the American Railway Association which will be held at the New Ocean House, Swampscott, Mass., on September 23, 24 and 25, the second day, Wednesday, will be set aside for the discussion of the subject of train control.

° ° °

The New York Central has ordered 12 Style S-8, electric lever units for application to the existing Saxby & Farmer mechanical interlocking machine at Painesville, Ohio. The electric section of this machine will have ten working levers and two spare spaces. This machine is being furnished by the Union Switch & Signal Company and will be installed by the railroad company's signal construction forces.

° ° °

The New York, Chicago & St. Louis has placed an order with the General Railway Signal Company for one Style-R, 8-lever interlocking machine for installation at Latty, Ohio. The order also includes two model-2A top-post, 8-volt signals; 6 horizontal 2-way rotary switch circuit controllers; 5 universal switch circuit controllers; 7 vertical rotary switch circuit controllers; six 500-ohm electric locks; 28 Model-13 relays and 4 Model-12 polarized relays.

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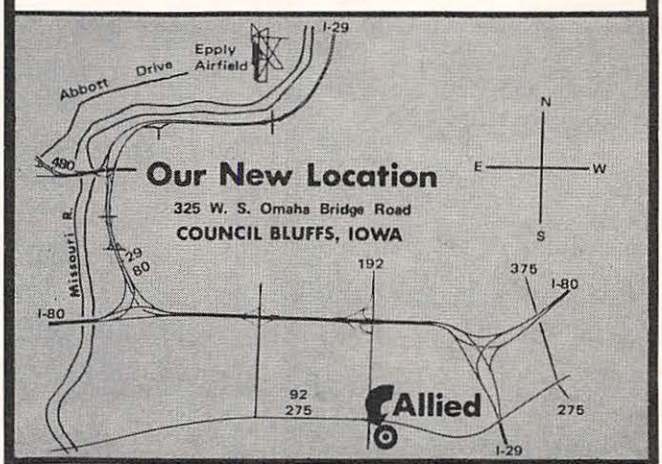

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AAR COMMUNICATION AND SIGNAL SECTION

HYATT REGENCY ATLANTA
ATLANTA, GEORGIA
SEPT. 16-18, 1974

CONVENTION PROGRAM

MONDAY, SEPT. 16

9:00 a.m.—General Session (The Falcon Room).

9:15 a.m.—Keynote Address: W. G. Claytor, Jr., President, Southern.

9:35 a.m.—Remarks: W. Hinchman, Chief Common Carrier Bureau, Federal Communication Commission.

10:00 a.m.—Remarks: C. J. Chamberlain, President, Brotherhood of Railway Signalmen.

10:20 a.m.—Remarks: J. W. Hansen, Chairman and President, Railway Systems Suppliers, Inc.

10:30 a.m.—Remarks: W. E. Loftus, Acting Associate Administrator, Office of Policy and Plans, Federal Railroad Administration.

10:50 a.m.—Introduction of Life Members and VIPs.

11:00 a.m.—Reports of Special Committees.
—Interconnection
—Radio Liaison
—Signal Liaison

1:30 p.m.—(Lancaster D) "Advancements in Lightning Research and Protection"—Roy B. Carpenter, Jr., Director, Lightning Elimination Associates.

2:00 p.m.—"Application of Solar Energy to Railroad Communication and Signal Power Requirements"—Ellis E. Walker, Senior Marketing Engineer, Solar Power Corp.

2:30 p.m.-4:30 p.m.—Workshop Sessions

Committee A—Outside Plant Facilities (Essex Room)—Panel Discussions: "What to Expect of Future Cable Market—Availability of Polyethylene, PVC, Copper, Delivery, etc."—Messrs: W. J. Dorè (moderator), Southern Pacific; K. Loebl, Anaconda Wire & Cable; E. E. McIlveen, Okonite Co.

"Protection to Present Day Equipment"—Messrs. W. E. Bell (moderator), Erie Lackawanna; F. A. Kahl, Joslyn Electronics System; R. E. Nelson, Reliable Electric Co.; R. L. Pike, Safetran Systems.

Committee G—Education and Training (Lancaster A&B)—"BN Signal Training Program," R. L. Schmidt, Engineer, Signal Training, Burlington, Northern; "CN Training Consulting Services," W. H. Cumberland, Manager, Training Development, Canadian National; "Signal Training Bulletins," Al Klinger, Editor, Railway System Controls; "Development of Technical Staff at WABCO," P. J. DeIvernois, Senior Consultant, Systems Engineering, Union Switch & Signal Division; "Audio Visual Training Aid," R. G. Nolting, Communications Supervisor, Supervisor, Chicago & North Western.

TUESDAY, SEPT. 17

9:00 a.m.—"Computer Based CTC and Advance Applications for Computerized Train Dispatching," A. C. Tauch, Sales Manager, Railway Systems, TRW Controls.

9:30 a.m.—"Network Monitoring and Control of Data Communications Facilities," R. C. Karvwatt, Director-Communications Services, Penn Central.

10:00 a.m.-12 Noon—Workshop Sessions

Committee C—Communications and Data Systems (Essex Room)—"Considerations in Applying Data to Microwave Systems," John Hagen, Engineer, Motorola; "Penn Central Automated Technical Control Facility," L. J. Ritter, Manager Communications-Planning Operations, Penn Central; "Large Scale Automated Technical Control Facility," L. Calden, Communications System Engineer, Honeywell; "Manual Technical Control Facility," L. Dixon, Vice President Technical Marketing, RF Communications, Harris Corp.

Committee E—Interlocking, Traffic Control and Block Signal Systems (Lancaster A&B)—Panel Discussion: "Pulse Modulated Track Circuits,"—Messrs. R. C. Nagel (moderator), Southern Pacific; T. C. Haney, Santa Fe; J. A. Turner, Southern Pacific; J. E. Moe, Safetran.

1:30 p.m.—Panel Discussion: Inductive Interference Committee, Messrs. W. D. Archer (moderator), Director Planning & Special Projects, Illinois Central Gulf P. M. Abaray, Signal Engineer, Union R.R.; J. G. Cunningham, Engineer, Communication & Signal Staff, Penn Central; A. Getty, Commonwealth Edison.

2:30-4:30 p.m.—Workshop Sessions

Committee B—Radio and Microwave Systems (Essex Room)—Panel Discussions: "RR Radio—Today's Considerations for Future Systems"—Messrs. H. L. Massie (moderator), Santa Fe; R. H. Brenneman, Union Pacific; C. D. Marlatt, British Columbia Ry.; J. W. Ormiston, Canadian National; J. Kraav, Canadian Pacific; J. C. Taylor, Illinois Central Gulf; O. Bothun, Storno; K. Fisher, Telefunken; A. E. Jones, WABCO.

"A Look at Part 94 and its Effect on Private Microwave Users"—Messrs. R. B. Blaylock (moderator), Frisco; S. R. McConoughey, Federal Communication Commission; J. E. Bistrup, Farinon.

"Docket 18262-150 MHz of New Spectrum for Land Mobile Services"—Messrs. H. M. Robertson (moderator), AAR; J. V. Herbert, Canadian Nation-

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al; C. A. Higginbotham and G. Petrutsas, Federal Communication Commission; J. A. McCormick, General Electric.

Committee D—Highway Grade Crossing Protection (Lancaster A&B)—"Review of Bulletin No. 7," P. H. Foley, Engineer C&S Section, AAR; "Research Program-DOT Highway Research Group," Dr. J. B. Hopkins, Transportation Systems Center, DOT; "1973 Highway Act-Sections 203 and 230," Messrs. R. Hunter, Federal Highway Administration and R. W. Carroll, Coordinating Engineer, Kansas Highway Department.

"Open Forum"—Messrs. B. J. Hutton (moderator), Santa Fe; R. V. Waterman, Seaboard Coast Line; R. M. McIntosh, Canadian Railway Transport Committee; J. E. Moe, Safetran; E. A. Kraus, Union Pacific; V. A. McGregor, Canadian National.

AAR DATA SYSTEMS DIVISION

HYATT REGENCY ATLANTA
ATLANTA, GEORGIA
SEPT. 18-20, 1974

CONVENTION PROGRAM

WEDNESDAY, SEPT. 18

JOINT SESSION: Communication and Signal Section, AAR; and Data Systems Division, AAR.

9:00 a.m.—Reports of Standing Committees A thru G.

9:30 a.m.—Remarks: L. R. Raish, Consultant, Office of Telecommunications.

10:00 a.m.—"Implications of Modern Transit Signaling Concepts for Mainline Railroad Operation"—Dr. J. E. Freehafer, Manager of Advanced Engineering, and H. C. Kendall, Senior-Consultant, Technical Marketing, General Railway Signal Co.

10:30 a.m.—"Railroading 1980—Future Trends in Communication and Signaling"—D. D. Huffman, Vice President Engineering, WABCO.

11:00 a.m.—"C&S Section Chairman's Remarks"—N. C. Pace, Assistant Vice President-C&S, Southern.

12:15 p.m.—Joint Luncheon (The Condor Room)—Address: "The Future of Transportation & The Railroad Industry"—John W. Ingram, Federal Railroad Administrator.

1:30 p.m.—"Chairman's Remarks"—S. A. Alward, Vice President-Management Information Services, Seaboard Coast Line Railroad/Louisville & Nashville.

"Pressures Affecting the Railroad Industry"—P. M. Lanier, Senior Vice President-Law, Seaboard Coast Line Industries.

"TRAIN—An Industry Response"—Stephen Ailes, President and Chief Executive Officer, AAR.

"The Role of Management Systems"—James A. Bailey, Vice President, Management Systems Department, AAR.

THURSDAY, SEPT. 19

9 a.m.—General Session

"Ten Years of Progress"—R. A. Petrash, Executive Director, Data Systems Division, AAR.

Panel Discussion: "The Value of Data Systems"—Messrs. L. S. Crane, Executive Vive President, Southern J. W. Gessner, Vice President-Operations, Missouri Pacific; T. J. Lamphier, Executive Vice President, Burlington Northern; W. F. Thompson, Senior Vice President-Operations, St. Louis-San Francisco.

11:00 a.m.—Panel Discussion: "The Future of Data Systems"—Messrs. S. A. Alward, Vice President, Managemment Information Services, Seaboard Coast Line/Louisville & Nashville; R. M. Champion, Vice President, Information Systems, Santa Fe; J. W. Germany, Vice President, Management Services Southern Pacific; J. L. Jones, Vice President, Management Information Services, Southern.

12:00 Noon—Luncheon and Address: "Future of Computers"—Maj. Gen. J. B. Robbins, Director of Data Automation, United States Air Force.

1:30 p.m.—General Session: "An Appraisal and Approach"—A. D. Dingle, Consultant, ADD Systems.

"The Role of the Federal Railroad Administration"

3:15 p.m.—"TRAIN II—Progress Report"—M. A. Morris, Director, Systems Development Division, AAR.

FRIDAY, SEPT. 20

8:00 a.m.—Breakfast—"Outgoing Chairman's Remarks"—S. A. Alward, Vice President-Management Information Services, SCL/L&N.

"Incoming Chairman's Remarks"—J. W. Germany, Vice President-Management Services, Southern Pacific.

9:15 a.m.—Concurrent Workshops

Workshop #1—Systems Concept Group

Workshop #2—Systems & Data Communications Equipment

Workshop #3—Shipper-Carrier Data Systems

Workshop #4—Technical Advisory Group

Workshop #5—Automatic Car Identification

11:00 a.m.—Concurrent Workshops

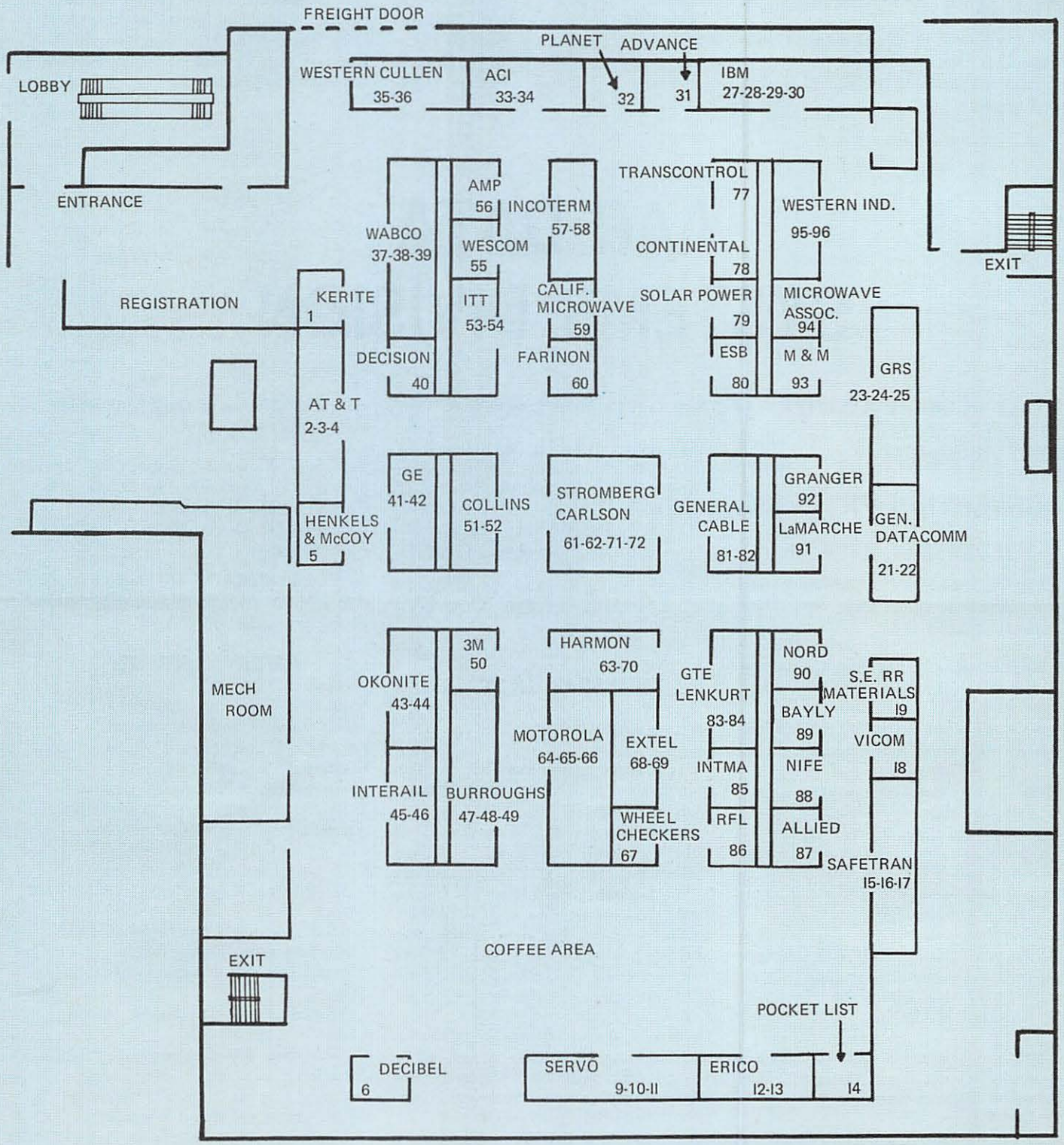
Workshop #5 (Continued)—Automatic Car Identification

Workshop #6—Interroad Procedures & Data Exchange

Workshop #7—Analytical Technique

Workshop #8—Data Processing Administration & Training

Workshop #9—Universal Machine Language Equipment Register



HYATT REGENCY ATLANTA

IVY EXHIBITION HALL

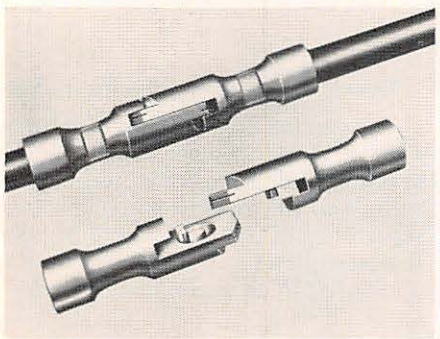
Products on Display

The following are manufacturers or their representatives who are exhibiting under the sponsorship of the Railway Systems Suppliers, Inc., as part of the Communication & Signal Section, AAR, and Data Systems Division, AAR, annual meetings. Below are descriptions of major products or services displayed at this Hyatt Regency Atlanta exhibit.

ACI Systems Corp., Computer Identics Corp. (Booths 33-34).

An Audio/visual presentation showing typical system applications now operating in the field of: Terminal Management Systems; Data Enhancement; Front End Processing.

Circle 101 on reader service card



AMP Special Industries (Booth 56).

AMPOWER quick disconnect terminals, designed primarily for the railway industry, are ideal for all applications with motors, generators, transformers and other electrical equipment involving large power cables where vibration and continuous operation are factors. Silver-plated to withstand higher temperatures, the quick disconnect is marked with both A.R.R. Cable designations and commercial wire range to assure correct cable-connector combinations, and is available in sizes 1/0 AWG to 500 MCM.

Other products for signal control, CTC, classification yards, railroad shops and locomotive repair are: PLASTI-BOND rings and terminals; PICA-BOND connectors and CHAMP cross connect blocks; lead-plated AMPOWER battery terminals; AMPOWER long barrel terminals and splices; SOLI-STRAND and PIDG terminals and splices; AMP-TY cable ties; AMPIL-LUME panel lights; coaxial connectors for UHF applications; and heat shrinkable products for cable repair.

Circle 102 on reader service card

Advance Industries, Inc. (Booth 31).

Telecommunications towers and buildings are available in a variety of heights and sizes to meet many requirements.

Circle 103 on reader service card

Allied Communications Equipment Co. (Booth 87).

Reconditioned and tested communication equipment including telephone carrier is available.

Circle 104 on reader service card

American Telephone & Telegraph Co. (Booths 2-3-4).

The Dataspeed 40 terminals combine high speed transmission and simple data preparation. Modular design of Dataspeed 40 permits the combination of cathode ray tube display, a hard copy printer and operating console. The system operates at 1200 bps, or 1200 characters. A demonstration, involving an operational scale model railroad, will show how the Dataspeed 40 can expedite classification of yard operations.

The Com Key 1434 is designed for flexibility, efficiency and low cost. The Com Key 1434 features up to 14 incoming lines and 34 individual telephones and allows small and medium-sized firms to select features and options in flexible communications packages.

The Touch-a-matic telephone brings automation to calling any of 31 numbers at the touch of a button. The 4A Speakerphone displayed with the Touch-a-matic leaves the users free to lock up records, take notes, even get up and walk around while he talks and listens.

Circle 105 on reader service card

Bayly Engineering Ltd. (Booth 89).

A waystation radio control system permits selection and control of up to 20 radio base stations on a common party line or voice circuit by a dispatcher using tone signaling.

Circle 106 on reader service card

Burroughs Corp. (Booths 47-48-49).

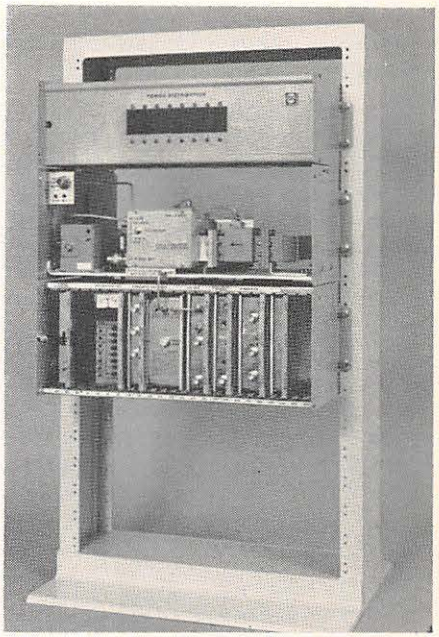
The L/TC series minicomputers are suitable for railroad applications including repetitive waybilling, train consist makeup, inquiry for car or waybill information, display and accounting functions.

Circle 107 on reader service card

California Microwave Inc. (Booth 59).

Microwave retrofit equipment is a specialty.

Circle 108 on reader service card



Collins Radio Co. (Booths 51-52).

The MW-328 is a solid-state microwave system designed for 6-GHz operation. Other key microwave products designed for industrial applications include, the MS-228 2-GHz microwave radio and the Collins low density multiplex, MX-128, and fault alarm system, the FA-201.

Circle 109 on reader service card

Continental Quality Industries, Inc. (Booth 78).

The ES hotbox detector features the capability of providing strip-chart detector readouts that take into account the different operating temperatures of friction and roller bearings. Electronic circuitry for processing electrical signals from the detector produce output signals representing temperatures in a range including both overheated friction bearings and overheated roller bearings comprising a non-linear amplifier having a steep initial gain characteristic for lower temperatures of overheated friction bearings and a shallow further gain characteristic for higher temperatures of overheated roller bearings.

Circle 110 on reader service card

Products on Display

(Continued from page 45)

Decibel Products, Inc. (Booth 6).

VHF radio antennas and coaxial lines are available in a variety of models to meet most any requirement.

Circle 111 on reader service card

Decision Data Computer Corp. (Booth 40).

The 9660 sorting data recorder can perform up to 18 different punch card handling functions—a complete auxiliary unit capable of relieving bottlenecks in keypunching, verifying, interpreting, card sorting, reproducing and interfiling. The following speeds are available: sorting—300 cards/min; reproducing—45-90 cpm; gang punching —60-120 cpm; blank card interfiling—200 cpm; interpreting—60-120 cpm; and data posting—45-90 cpm. An OEM interface is available to make the 9660 a peripheral on an existing EDP system.

Circle 112 on reader service card

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Booths **53** & **54**

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ESB, Inc., Exide (Booth 80).

The railway signal visible power primary cell electrolyte turns a luminescent green when it has expended about 80% of its rated capacity of 3,500 a.h. A complete line of lead-acid and nickel-cadmium are available for signaling and communication applications.

Circle 113 on reader service card

Erico Products, Inc. (Booths 12-13).

Grade crossing protection equipment using overlay track circuit techniques are a specialty.

Circle 114 on reader service card

Extel Corp. (Booths 68-69).

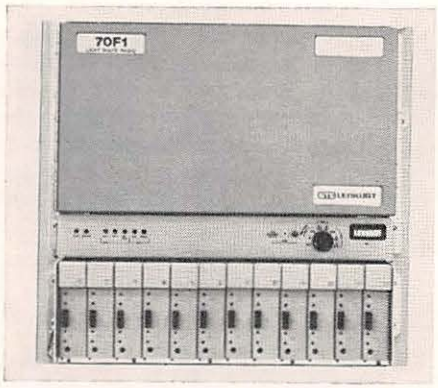
Series AC and AD receive-only teleprinters are fully compatible with standard teletypewriter signals and equipment. Miniature teleprinters are a specialty.

Circle 115 on reader service card

Farinon Electric (Booth 60).

Microwave and multiplex systems for multi-channel long distance message transmission is a specialty.

Circle 116 on reader service card



GTE Lenkurt, Inc. (Booths 83-84).

The 70F1 microwave radio is a low-cost narrowband system suited for light-route communications of message and data in the 2100 MHz to 2200 MHz frequency band. Designed for light-route and spur route applications, the 70F1 can transmit 12 channels in the industrial allocations.

The solid-state 70F1 transceiver is compactly packaged, with the entire assembly including built-in baseband equipment occupying only 12¼ inches of vertical space on a 19-inch wide equipment rack. A typical assembly, including 12-channels of multiplex equipment (type 36A), is only 17½ inches high, representing the most compact assembly of its kind available.

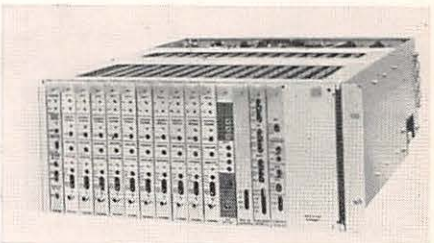
GTE Lenkurt's 46A3 Channel Equipment for Direct-To-Line or Directly Formed Supergroup Applications, and the type 36A Multiplex System are also on exhibit. The new 46A3 channel equipment can be used to place up to 132 voice frequency channels directly onto the HF line, or to form standard 312 kHz to 552 kHz 60-channel supergroups. Designed for light-route and spur-route microwave radio networks, the 72-channel 36A Multiplex System can readily be expanded to 180 channels with the addition of new supergroup equipment.

Circle 117 on reader service card

General Cable Corp. (Booths 81-82).

A complete buried cable installation service includes route survey, cable splicing, cable termination, cable pressurization, electrical testing, jointing of repeaters and other aspects of installation as required.

Circle 118 on reader service card



General DataComm Industries Inc. (Booths 21-22).

A complete range of data communications products, featuring the GDC 1251 Series of Synchronous Multiplexers. Also included are the 1202 Series of Time Division Multiplexers, the 1300 Series of Speech-Plus Terminals, a complete line of 100, 202 and 400 Series Asynchronous Modems, a complete line of GDC 201 Series Synchronous 2000/2400 bps Modems, and a line of data couplers, loop products, and data hubbing equipment. GDC will also provide information on its system engineering, service and leasing capabilities.

Circle 119 on reader service card

General Electric Co., Communication Systems Div. (Booth 41).

The TRS 696B 6-GHz microwave radio system will be joined in the showcase with the TRS 296 2-GHz microwave system. In addition, TCS 600A high density multiplex is displayed to round out the communications capability available when used with other transmission media as well as microwave. F-Signaling and Four Wire Termination equipment will add depth to the presentation of featured products for railroad communications.

Circle 120 on reader service card

General Electric Co. (Booth 42).

The hotbox detector data evaluator performs the function of a special purpose computer to simulate the actions of a highly skilled chart reader in evaluating hotbox detector data.

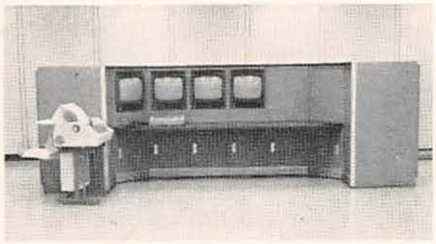
Circle 121 on reader service card

Granger Associates (Booth 92).

The Model 6010 960 MHz communications package is designed for low density, multi-channel point-to-point applications. The compact package requires only 10½ inches of rack mounting space to provide five 4KHz multiplex channels, service channel, power supply, transmitter and receiver.

System advantages include individually synchronized channels and C2 line conditioned; E & M signaling; identical channel frequency selected by plug-in oscillator; less path fading due to thermal ducting, and reduced torsional stability requirements to permit the use of less costly antenna support structures. The compact system is FCC type accepted for parts 81, 87, 89, 91 and 93, 100 F9 up to 500 F9 emission.

Circle 122 on reader service card



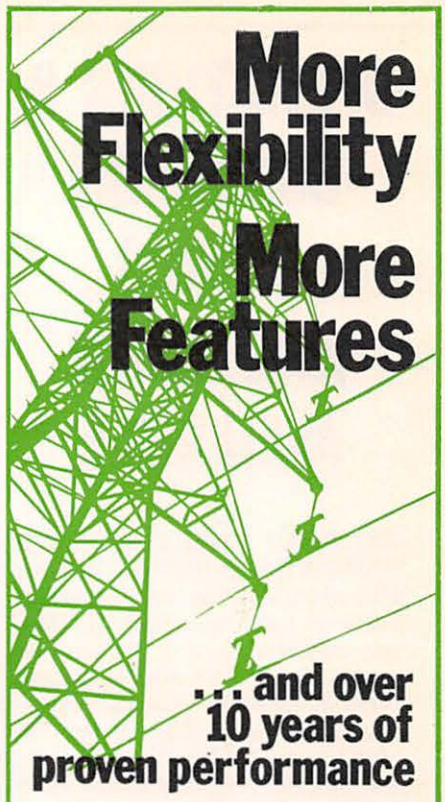
General Railway Signal Co. (Booths 23-24-25).

The GRS computer-based control center console—Traffic Master II—uses video display monitors with color cathode ray tubes (CRTs) to provide easy recognition of conditions existing in the controlled territory. Traffic Master II consists of overview CRTs which show the entire track layout; a compact control keyboard; and a control CRT which provides an enlarged display of a selected portion of the CTC territory. The overview displays include, in clearly distinguished colors, current route alignments, and track occupancy and blocking indications. The control display includes, also in color, the current status of route alignment, signal indications, track circuit occupancies, blocking, and alarms.

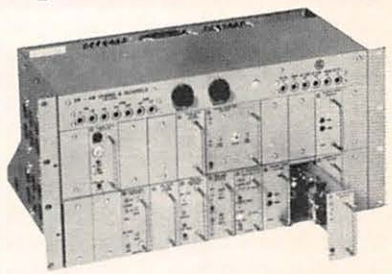
For interlocking applications, the Traffic Master II console consists of control CRTs, which display the entire track layout, and one or more keyboards. Control is based on the NX principle. As with CTC, current operating conditions are displayed on the CRTs in color.

Four colors provide basic routing and track occupancy information on both the CTC and interlocking Traffic Master II consoles: White-unselected, unoccupied route with signal at stop; Yellow-selected, unlocked route with signal at stop; Green-selected, locked route with signal clear; and Red-occupied with signal at stop. Additional colors are available for special purposes, such as track or signal blocking, as desired.

An important adjunct to Traffic Master II is its capability to handle Man-



RFL Power Line/ Open Wire Carrier



RFL's experience in Power Line/ Open Wire Carrier has led to an exclusive series of all-solid-state, single-sideband voice grade carrier channels, featuring highest quality channels for voice, tone transmission, or speech plus. Flexibility is provided by plug-in modules for each separate function. Convenience in system monitoring and service is yours, since all basic modules including filters are provided with front panel test points and controls where applicable.

RFL's complete line includes system regulators, compandors and power outputs to 25 watts.

RFL supplies complete communications systems including telephone equipment and line coupling devices. Please send your overall requirements for specific application information.

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AAR Show Booth No. 86
Circle 22 on Reader Service Card.

OPERATIONS & SIGNALING BASICS ARE AGAIN AVAILABLE

RAILROAD OPERATION AND RAILWAY SIGNALING: The basic text which explains the relationship between train operation and railway signaling is now available in reprint form. The text is in the form of questions and answers so that the reader may know the objective of the information given, and to place emphasis upon the "why" and "how" of railway signaling and railroad operation.

Topics covered include fixed signals, block signaling, interlockings, centralized traffic control, cab signals and highway grade crossing protection. This is a reprint of the 1953 edition of RAILROAD OPERATION AND RAILWAY SIGNALING by Edmund J. Phillips, Jr., Simmons-Boardman Publishing Corp., 350 Broadway, New York, N.Y. 10013. Softbound. Price: 1 to 9 copies at $5.95 each; 10 or more copies at $5.00 each. To obtain copies, please fill out the coupon and send check or money order along with your order.

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City _____ State _____ Zip _____

Products on Display

(Continued from page 47)

agement Information Services wherein computer-stored information is instantly available as a CRT display or hard copy printout.

Circle 123 on reader service card

Harmon Electronics (Booths 63-70).

A line of grade crossing protection equipment including Harmons digital motion detector which combines new concepts in train detection with state-of-the-art techniques in electronics to provide a very effective stand-alone system to detect approaching trains from a single location at the crossing. Use of this type of control will minimize the amount of engineering, wiring and other devices required to control even a fairly complex crossing layout.

Also, a new and improved design of the mechanism employed in crossing gates along with other specialties involved with CTC and other signal control equipment.

Circle 124 on reader service card

Henkels & McCoy, Inc. (Booth 5).

A rail-car vibratory plow can lay in multiconductor cables at track side at varying depths. An advantage is that rail equipment and rail crews can handle placing of the cables.

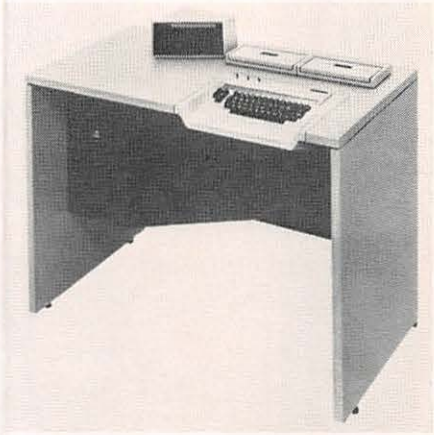
Circle 125 on reader service card

Incoterm Corp. (Booths 57-58).

The Incoterm SPD 900 Remote Batch Terminal System operates as a replacement for existing, card oriented, batch processing communication systems. The equipment will include visual display units, a card reader/punch, and a printer capable of speeds up to 165 characters per second. The system also will demonstrate a dual, flexible diskette for on-line storage of data and user programs. The SPD 900 will emulate functions currently performed by other systems and demonstrate how standard tabulating equipment can be replaced.

The Incoterm SPD 320 is a direct replacement for the IBM 3270 Terminal Display System at significantly improved price performance. The SPD 320 system features include three screen sizes (480, 960, 1920 characters), transmission speeds up to 9600 baud, an optional printer per display unit capable of printing at 165 characters per second and field blink.

Circle 126 on reader service card



IBM Corp. (Booths 73-74-75-76).

IBM's 3740 data entry system can be utilized for freight car movement reporting and car inquiry applications as well as data entry techniques for waybill processing. Components of the 3740 system are the 3741 programmable work station, the 3713 serial matrix printer and the 129 data card recorder.

The work station is a recently announced enhancement to the data entry system. It allows users at remote or decentralized sites to process and edit information before it is entered into a computer. The 3713 attaches to all 3741 models, providing hard copy of data recorded on diskettes or information transmitted from a central computer.

The car movement reporting application provides information on the location and status of freight cars and trains, while car inquiry allows users to locate cars and accurately estimate arrival time. The waybilling application generates transportation and revenue documents needed to initiate car movement and collect for services.

Circle 127 on reader service card

Intma International, Inc. (Booth 85).

An adhesive-bonded insulated joint is especially designed for use in welded rail territory. The insulated joint is furnished factory assembled in rail lengths of 10, 11 and 13 ft. or longer.

Circle 128 on reader service card

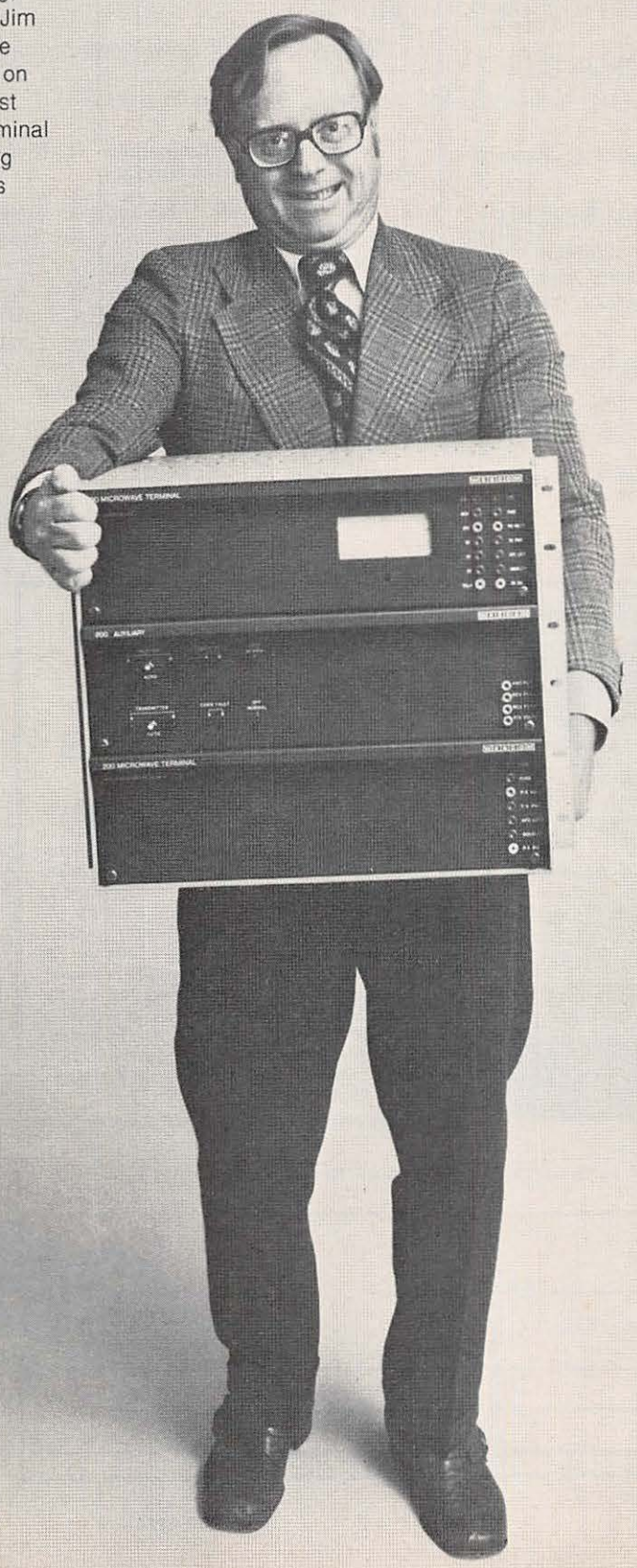
Can a 150 Pound Man Lift a Protected Microwave Terminal?

He can, if it's a Wescom Series 200 System.

Our point. Size. This 2GHz Terminal with hot standby and orderwire weighs under 100 lbs. and takes only 15¾ inches of rack space.

The man shown here, with only moderately white knuckles, is Jim Lang, Manager of our Microwave operation. Jim had reason to appreciate the size of the 200 Terminal last winter. He balanced on the pontoon of a light plane off the coast of Alaska, and handed a protected terminal to an RCA Alascom technician standing in a motorboat. That terminal now links the FAA at Biorka Island with Sitka.

While your real life situation might not be so precarious, compact size, roll-out equipment drawers, and modular internal packaging allow our 2GHz Terminal to be installed nearly anywhere, and maintained by nearly anyone.



WESCOM

Products on Display

(Continued from page 48)

Interail, Inc. (Booths 45-46).

Computer Terminal equipment is a specialty.

Circle 129 on reader service card

Kerite Company (Booth 1).

Insulated multiconductor signal cable is a specialty.

Circle 130 on reader service card

LaMarche Mfg. Co. (Booth 91).

Float chargers for signaling and communication systems are a specialty.

Circle 131 on reader service card

M&M Contracting Co. (Booth 93).

Mechanized plowing in of underground multiconductor cable is available.

Circle 132 on reader service card

3M Company (Booth 50).

Insulated rail joints and crossing gate arms are a specialty.

Circle 133 on reader service card

Microwave Associates, Inc. (Booth 94).

Manufacture of microwave equipment is a speciality.

Circle 134 on reader service card

Motorola Communications & Electronics, Inc. (Booths 64-65-66).

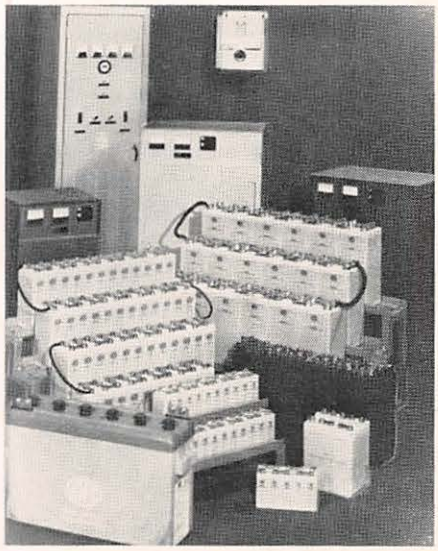
Microwave radio and railroad associated communications equipment are featured including: Locomotive Two-Way Radio; Automotive Two-Way Radio; Portable Two-Way Radio; Radio Paging; Microwave Systems; and Closed Circuit Television.

Circle 135 on reader service card

Nord Instruments, Inc. (Booth 90).

Wayside radio to train equipment and various test equipment which provides on-the-spot diagnosis of locomotive radio system problems is available.

Circle 136 on reader service card



NIFE, Inc. (Booth 88).

NIFE nickel cadmium storage batteries are of pocket plate construction. The pockets are made with finely perforated nickel-plated steel strips formed into channels into which the active material is placed. A perforated steel cover strip is crimped into place to form a permanent envelope. Exhibit is of the nickel cadmium alkaline storage batteries for railway applications.

Circle 137 on reader service card

The Okonite Co. (Booths 43-44).

Signal, communications and control cables are specialties.

Circle 138 on reader service card

Pocket List of RR Officials (Booth 14).

Railroad and supply company officials directory listing is a specialty.

Circle 139 on reader service card

Planet Corp. (Booth 32).

Manufacture, assembly and erection of signal bridges are a specialty.

Circle 140 on reader service card

GIANT RAND MCNALLY RAILROAD ATLAS

Everyone who is involved with railroads will want the "GREAT VISUALIZER". With the Rand McNally Atlas you can easily pinpoint any of 350,000 miles of track you hear of, read of in newspapers, or talk of with friends. It's all here. A thick 60 pages of bright 2-color spreads each opening to a big, full 1 foot by 1½ feet. 30 complete maps in all. It's been called a map "warehouse", and you can do a hundred things with them: take along on a trip; frame them; give as gifts. Included: 1) Big double page Canada map in 2 colors, and 2) Full page Amtrak Routes. Only $3.45 per copy.

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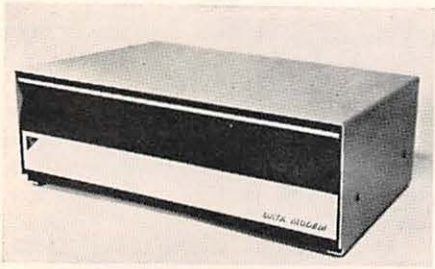

RFL Industries, Inc. (Booth 86).

A line of solid-state single sideband voice grade carrier channels, AM and FS voice frequency carriers accommodate all tone channel requirements, data modems and multiplexing data systems.

Circle 141 on reader service card

Safetran Systems Corp. (Booths 15-16-17).

Safetran's Mobile Radio Access System (MRAS) is a system whereby a remote radio can dial directly through its base station, by means of a touch tone pad mounted on the radio, to any telephone within the commercial phone system.

The Central Dispatcher Radio Control (CDRC) system can select a given field station, by touch tone, and attain communications with this field station and its associated mobile units. The system will display a dispatchers console, capable of operating most communications systems.

For signaling–Safetran is featuring the Phase Shift Overlay (PSO), with its high interference immunity, low transmitter distortion, and strappable gain (no potentiometers).

A new Pultruded fiberglass gate arm section will be available for inspection. The pultrusion methods allow for greater strength and more rigidity.

Circle 142 on reader service card

Servo Corp. of America (Booths 9-10-11).

The KarTrak Automatic Car Identification system is a computer-based, fully-integrated total system for automatic car identification which provides accurate and useful car movement data. The use of complete system applications which will offer to the railroads an efficient, cost-effective operation for car movement control and information is highly stressed.

New capabilities which may be added to existing Hot Box Detector systems or purchased as options on new installations include the Wheel Safety Monitor which detects overheated wheels caused by stuck brakes, flat wheels, etc.

Another important product add-on this year is the Universal Alarm System which assists operating personnel to automatically differentiate between roller bearings and friction bearings.

Circle 143 on reader service card

FAX

Waybills, switching lists, maintenance orders, drawings—all can easily be transmitted locally at 1 to 3 minutes per page on Copyphone—a totally automatic facsimile system from turn-on to unattended receiving.

By adding the optional automatic document loader, up to 50 documents of varying sizes can be transmitted to unattended receivers over existing telephone lines, microwave, or radio. Received copies are automatically cut to the same size as the original. A wide variety of facsimile papers are available to fit your specific system.

This speedy and accurate method of transmitting essential information requires no trained operators and eliminates errors common with voice communications.

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Circle 23 on Reader Service Card.

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NICKEL CADMIUM BATTERIES
BATTERY CHARGERS
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NATIONAL ELECTRIC GATE COMPANY
Division of NECCO
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Elk Grove, Il. 60007
Wooden & Fibre-Glass Gate Arms
Lamps-Gate Arm Products-Mechs.
Circle 24 on Reader Service Card.

Products on Display

(Continued from page 51)

Solar Power Corp. (Booth 79).

Silicon solar cell modules are available for providing power to maintain a charge on batteries used for signaling and communication systems. Each solar module consists of five silicon solar cells connected in series to supply 0.5 amp at 2.2 volts in direct sunlight. Solar modules are arrayed in series and parallel combinations to match the current and voltage requirements of the load.

Circle 144 on reader service card

Stromberg-Carlson Corp. (Booths 61-62-71-72).

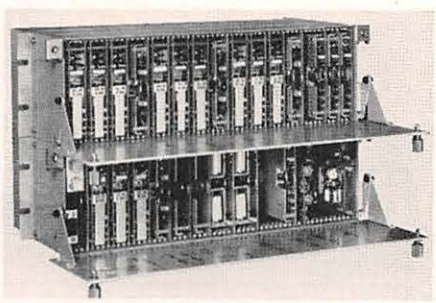
An electronic PBX which features solid-state modules, less floor space requirements and greater flexibility than electromechanical systems, is available along with other special telephone equipment.

Circle 145 on reader service card

Transcontrol Corp. (Booths 95-96).

Overlay track circuit controls for highway crossing protection including: Highway crossing alarm system which indicates that a gate is down or crossing lights are flashing when a failure occurs; PD-1 relays; HX-1 highway crossing unit, which provides continuous AC power for four AC-DC highway crossing track circuits; ST-3 rectifier for AC-DC track circuits; 8⅜ inch doublet type aluminum color light signal.

Circle 146 on reader service card



Transmission Dept., ITT Telecommunications (Booths 53-54).

The K65F is a completely solid-state low density frequency division multiplex system; designed to fill the need for economical extraction of a small number of channels from supergroups 1 and 2 of an existing high density multiplex system. The K65F employs a two step modulation plan in order to develop the baseband frequency spectrum. Three channel pregroups occupying the 12 KHz to 24 KHz frequency spectrum are formed in the first modulation step. The second modulation step translates a pregroup directly to the applicable portion of the baseband spectrum.

Also on display are the A332, 2-GHz; MI-6, 6-GHz; MI-12, 12-GHz Microwave Radio systems along with the K65C multiplex system.

Circle 147 on reader service card

Union Switch & Signal Division, WABCO (Booths 37-38-39).

WABCO's line of railroad two-way radio equipment is to include: the 4R Radio with 12 channel capability; Mobile Portable; Packset; Locomotive/Caboose Control Unit with built in speaker/mike; Total Radio Control—both dispatcher panel and field communications rack.

Other signal and communication equipment includes: Cor-Ten Steel Instrument Case housing equipment for a packaged grade crossing installation; a new line of automatic rectifiers; a new line of transformers; a Motion Monitor for grade crossing protection control; a new aluminum gate arm and adapter bracket for mounting on most other manufacturers mechanisms; and a new gunn diode radar for classification yard speed measurement.

Circle 148 on reader service card

Vicom Division, Vidar Corp. (Booth 18).

Pulse code modulation microwave and multiplex equipment can meet any requirement for data transmission.

Circle 149 on reader service card

Western-Cullen Division, Federal Sign & Signal Corp. (Booths 35-36).

Highway grade crossing equipment including the following: MTC-100 Modulated Track Circuit Transmitter and Receiver; Fiberglass Gate Arm, Gate Arm Adapters, and Gate Lights; Type 975-201—12 inch Light Units, for Highway Crossing Protection; Types 3567 and 3568 Highway Crossing Gate Mechanisms; Redesigned and improved 720 EOR Solid State Flasher Relay for Flashing Highway Crossing Lights;

Walkout Cantilevers; and the WC-74-SE Screech Eliminator Shoes for Retarders.

Circle 150 on reader service card

Wescom, Inc. (Booth 55).

The Series 200 Microwave system (2GHz band terminal, switching and combining equipment) is designed for use in FDM, Video and PCM microwave relay applications.

Modular transmitter, receiver LO, baseband amplifier and other functional elements, along with color keyed test points and corresponding built-in panel meter, all mounted in a pull-out drawer, enable the end user to easily maintain the 200 Microwave System. The transmitter, using a single 2-GHz rf power transistor in a unique directional coupler oscillator circuit, attains .001% stability with simple AFC.

The 6600 Inband Signaling System consists of sixteen basic signaling modules, common equipment, and shelving providing variations of E and M, loop, foreign exchange and ringdown modes of SF signaling. Terminating sets, equalizers, pulse correctors, CGA circuitry, repeat coils and other related equipment are built into the signaling modules, enabling termination of 204 complete SF circuits in one 11½ foot by 19 inch bay.

Circle 151 on reader service card

Western Industries Ltd. (Booth 77).

Signaling equipment is a specialty including an Audio Frequency Overlay track circuit for use on jointless track circuit applications.

Circle 152 on reader service card

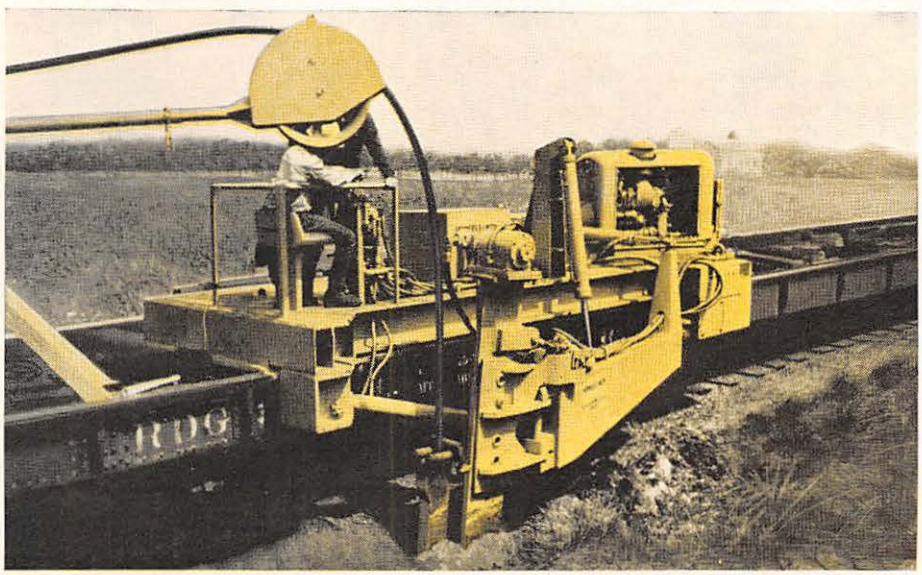
Wheel Checkers (Booth 67).

Broken flange and loose wheel detectors are a specialty. An electronic dragging equipment detector is available which is said to find 80 to 90 percent more dangerous defects than conventional detectors by scanning across the head of the rail with a near infrared light beam and thus closing the critical gap that is normally ignored.

A new concept in "cracked wheel" detection is soon to be available.

Circle 153 on reader service card

NOW...underground cable for railroads H&M does the groundwork



Underground cable is now being laid by rail. Henkels & McCoy's new railroad plow features a unique vibratory blade, mounted on a flatbed car. The plow is effective even in tough terrain and narrow gorges . . . lays cable automatically, and requires minimum tamping to replace the disturbed ground.

Railroads are now taking advantage of this new, highly efficient communication development to eliminate costly overhead lines and to reap the benefits of underground cable uninterrupted by storms and other disasters.

See for yourself how this modern cable laying technique can benefit your company. Call or write for an early viewing of a 16 mm. full-color sound film.

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Circle 25 on Reader Service Card.

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(Figures below are total given under specific categories in Business Analysis of Circulation NO. 18 SRDS, Aug. '74 edition).

CIRCULATION COMPARISON	Railway Age / Railway System Controls	MR	PR
CIRCULATION – Signaling & Communications Dept.	(224) (1,612) 1,836	1,249	722
CIRCULATION – General Executives	(6,141) (251) 6,392	5,963	2,513
TOTAL EFFECTIVE CIRCULATION	8,228	7,212	3,245
ADVERTISING COST (per 12 pages)	$8,058*	$12,840	$5,700
COST PER THOUSAND PER PAGE	$97.93	$178.03	$175.65

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*Two 6x contracts get 12 time rate

Note: In combining RAILWAY AGE and RAILWAY SYSTEM CONTROLS there is a factor of duplication. Where duplication exists, in top supervisor areas, your advertising receives double readership through two ads.

Recommended practices for Grade Crossing Warning Systems

One of the functions which the AAR provides is the compilation of recommended practices intended to foster safety at public highway grade crossings with railroads. Rightfully assuming that the main cause of grade crossing accidents is the failure of the motor vehicle operator to exercise due care and caution when approaching a grade crossing, warning equipment can play a big part in making the driver aware of danger.

Technological changes in available materials and methods used in development of warning devices and systems, as well as changes in highway concepts, require periodic review of recommendations to determine what adjustments, if any, are needed to provide maximum benefits from available resources. In the last four decades six bulletins have been published.

The recommended practices contained in bulletin number seven, which has just been made available, are composite evaluations from sources in the railroad industry, Federal and state governments and manufacturers of grade crossing equipment.

The recommendations are intended to serve as guidelines only and are not to be taken or interpreted as absolute standards to be followed in all circumstances.

Following is the first part of a two part series covering the information found in the AAR's "Recommended Practices", Bulletin No. 7.

The recommended practices contained in this bulletin are intended for use in both new installations and where general replacement of present apparatus is to be made, consistent with Federal and state laws and regulations.

Specifications and drawings referred to herein are those contained in the Signal Manual, AAR Communication and Signal Section, and the American Railway Engineering Association (AREA) Manual.

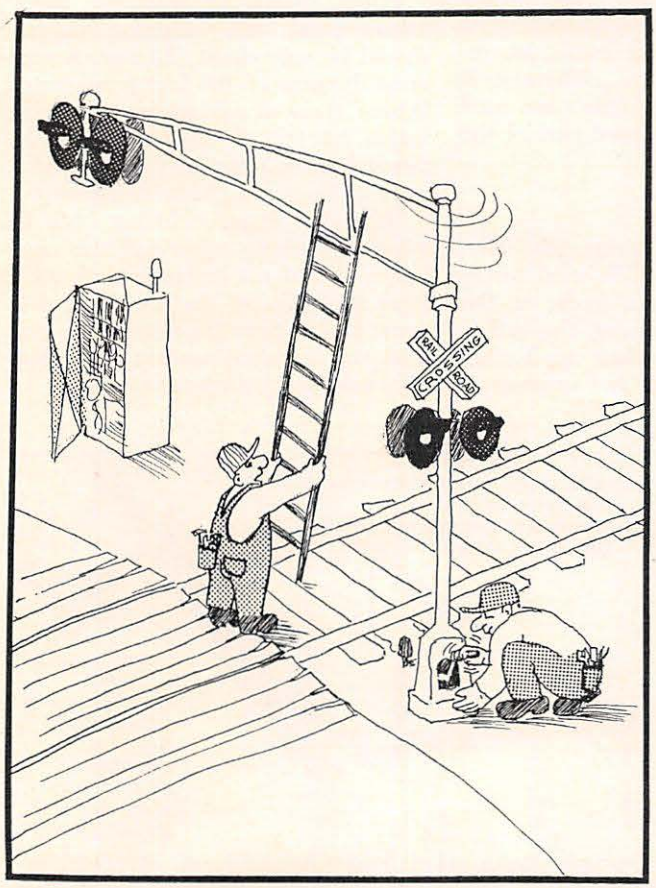
The Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD) referred to in this bulletin is the publication prepared by a National Joint Committee on Uniform Traffic Control Devices. This Manual has been adopted and published by the Federal Highway Administration as a national standard for application on all classes of roads and streets, including the approaches and crossings of railroad tracks.

The Uniform Vehicle Code (UVC) referred to herein is a publication of the National Committee on Uniform Traffic Laws and Ordinances.

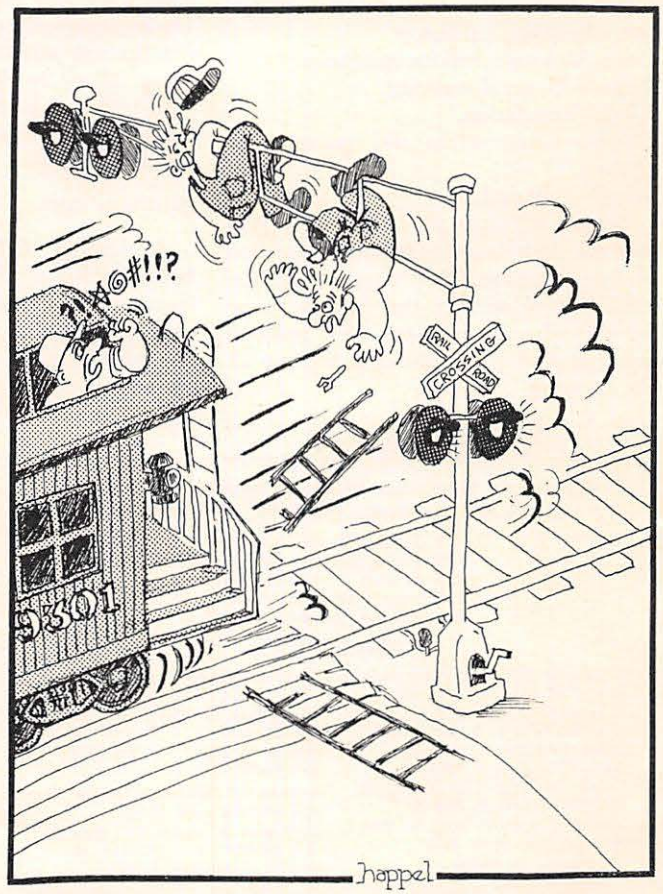
General provisions

In order to set forth the provisions of this bulletin in a clear and meaningful manner, certain basic principles in the MUTCD are repeated here as applicable to grade crossing warning devices.

Five basic considerations of traffic control devices are employed to stimulate effective reaction of the driver. They are design, placement, operation, maintenance and uniformity. Design incorporates such features as size, contrast, colors, shape, composition, lighting and reflectorization. Any sign having significance at night shall be reflectorized. Placement and operation of any device should assure that the equipment meets traffic requirements in a uniform and consistent manner. Maintenance should be adequate to preserve



Good! Now we'll get better footing for the ladder . . .



HEY!! Where'd you come from?!?!

operation, legibility and visibility. Achieving uniformity requires treating similar situations in the same manner. It is generally understood that no two crossings are alike and the decision to use a particular device at a crossing should be based on an engineering study at the site. While the recommended practices contained herein support standardization in design and application, they are not intended as a substitute for engineering judgment, nor a legal requirement for installation.

For the purpose of this bulletin the meaning of the words Shall, Should, and May is the same as that which appears in the MUTCD:

Shall—A mandatory condition. Where certain requirements in the design or application of the device are described with the 'shall' stipulation, it is mandatory when an installation is made that these requirements be met.

Should—An advisory condition. Where the word 'should' is used it is considered to be advisable usage, recommended but not mandatory.

May—A permissive condition. No requirement for design or application is intended.

The uniform use of colors as a method of identifying certain categories of traffic control devices is very important. The MUTCD prescribes use of certain colors as follows:

Red—Stop or prohibition.

Green—Indicated movements permitted, direction, guidance.

Blue—Motorists service guidance.

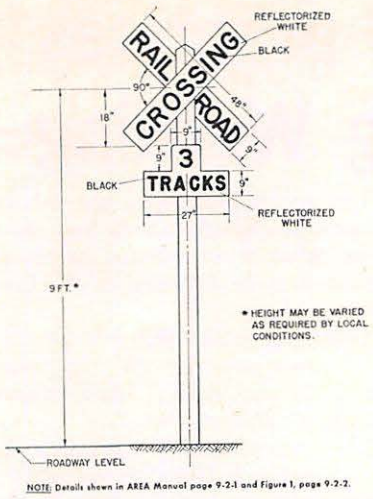
Yellow—General warning.

Black—Regulation.

Orange—Construction and maintenance signing.

White—Regulation.

Shapes of signs also play an important role in promoting quick recognition of signs. Among other assignments, the MUTCD prescribes the round shape for the advance warning of a railroad crossing and the crossbuck for use at the crossing.



NOTE: Details shown in AREA Manual page 9-2-1 and Figure 1, page 9-2-2.

RAILROAD-HIGHWAY CROSSING SIGN

(MUTCD R15-1,2)

FIGURE 1

Warning signs specified herein cover most conditions that are likely to be met. If other warnings are needed, the signs shall be of standard shape and color for warning signs, and the legends shall be brief and easily understood.

Signs

Railroad-highway crossing sign

The railroad-highway crossing sign (crossbuck) is illustrated in Figure 1. Where physically feasible and visible to approaching traffic, this sign shall be installed on the right hand side of the roadway on each approach to the crossing, except where local conditions require alternate location. Where railroad-highway crossing signals are used the crossbuck is an integral part of the signal assembly.

Auxiliary signs

A Number of Tracks sign, also illustrated in Figure 1 shall be used where there are two or more tracks at the crossing. Details governing the reflectorized materials and their application for both the crossbuck and number of tracks sign are available in Signal Manual Part 44.

A DO NOT STOP ON TRACKS sign, may be used where it is desirable to remind the operator of a vehicle that stopping on the tracks is prohibited as provided in Section 11-1112 of the UVC which reads as follows:

"No driver shall enter an intersection or marked crosswalk or drive onto any railroad grade crossing unless there is sufficient space on the other side of the intersection, crosswalk or railroad grade crossing to accommodate the vehicle he is operating without obstructing the passage of other vehicles, pedestrians or railroad trains notwithstanding any traffic-control signal indication to proceed."

A Railroad Advance Warning sign is required by the MUTCD in advance of every railroad crossing except minor spurs or in business districts or where physical characteristics are such that even a partially effective display of the sign is impossible. The railroad advance warning signs are usually off the railroad right-of-way and are properly the responsibility of the public authorities. Placement of this sign is covered by the MUTCD in Sections 2C-3 and 2C-31. In rural areas warning signs should be placed about 750 feet in advance of the crossing. On high speed roads advance warning signs may have to be placed 1500 feet or more in advance of the crossing.

Where speeds are relatively low in urban areas, the advance distance should be only about 250 feet. A minimum distance of 100 feet is suggested. Where there is an intersecting street within 100 feet of the crossing an additional sign or signs may be placed to warn traffic approaching the crossing.

Normally, signs, including both the advance warning signs and the crossbucks, should not be closer than 6 feet from the edge of the shoulder, or if none, 12 feet from the edge of the traveled way. In urban areas a lesser clearance may be used when necessary.

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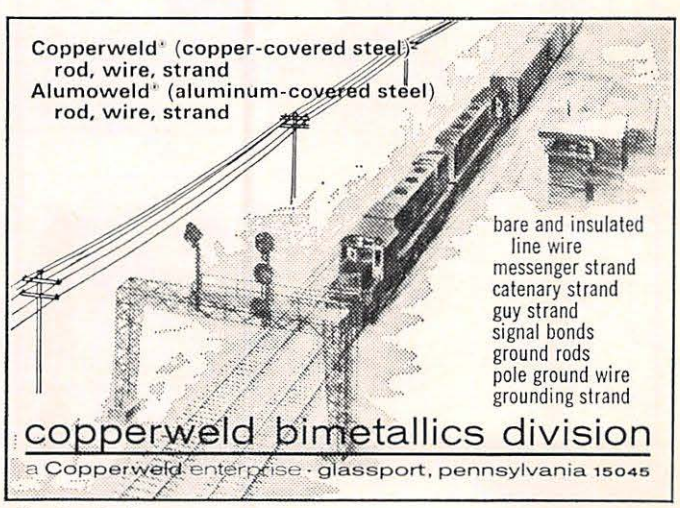

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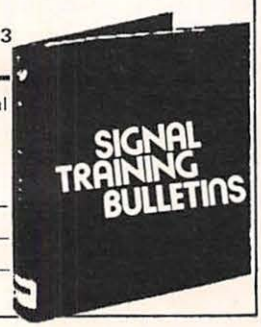

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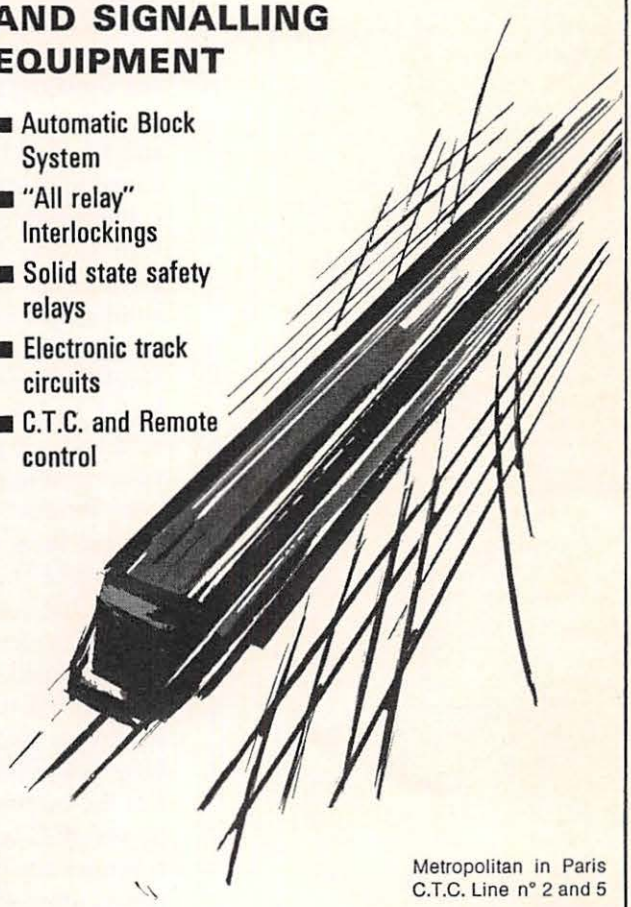

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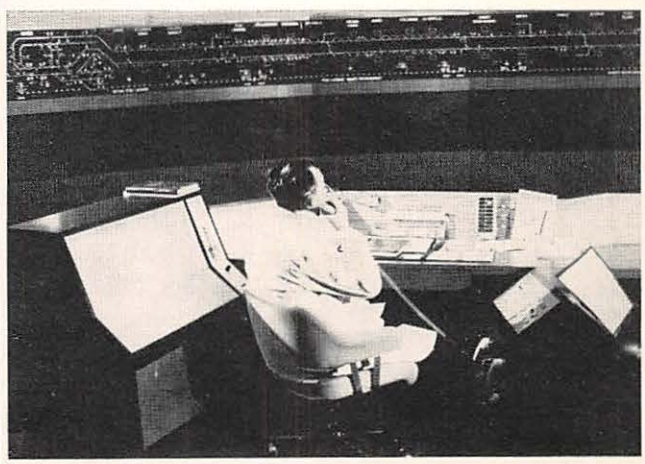

SAFETY - RELIABILITY

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Railway Signalman "Most Wanted" Man of the Year

What is ahead for the railway signalman in the next decade? Will the C&S departments gain in stature? How will the situation in the northeast affect the lives and fortunes of those who are readers of this specialized magazine? And of those who are associated with the manufacturing arm of the C&S departments—those who supply the tools, the hardware and much of the technology that keeps the trains running and that keeps them apart?

The answers to all these questions just have to be favorable ones. If you could chart C&S activity, the upward line would burst out of the upper right hand corner of the chart.

At first glance the situation in the northeast appears to be one of doom and gloom. Under the Regional Rail Reorganization Act of 1973, substantial mileage is to be abandoned. Yards and terminals are to be combined. But the Act also mandates that Conrail "operate and modernize parts or all of the restructured system." That is where C&S comes in. Clearly the surviving lines are going to have to become arteries through which increased and concentrated traffic flow efficiently. They will have to incorporate the most modern signaling systems, the most effective communications and controls, and the latest in facilities for yards and terminals. They will require increased and improved protection of crossings at grade. They will have to be maintained in tip-top condition.

Increased expansion of Amtrak nationally, the restoration of passenger services over freight-only lines, and the development of high-speed intercity services all will accentuate the demands for modernized signaling, communications and controls. Present planning even contemplates development of alternate freight routes where high speed passenger services are to be developed and expanded, requiring near-exclusive use of those routes. Rapid transit developments, too, point toward increased demands on the signalman as planners increasingly eye rail routes out of their cities for development of low cost transit rights-of-way.

Electrification, which seems certain to be in the future of many high density rail lines, freight and passenger alike, will create great demand for the services of the C&S department. Entire main lines may have to be resignaled, first for compatability with electrification, and second to handle increased movements at accelerated speeds.

Where will the money come from to pay for these extensive and ambitious projects? That is less a problem than it has been in recent memory. For the bankrupts that are to be included in the ultimate Conrail system, there are $100's of millions available—$500 million for corridor improvements alone. For the railroads nationwide, the landmark 10% freight rate increase granted by the ICC in June specifies that the carriers must spend all the increased revenues for capital improvements, or for catching up on deferred maintenance, after allowing for increased costs of materials. That will add up, it is estimated, to $1 billion-plus. Amtrak has generous provisions for improvements on its own. A segment of the Highway Trust Fund is now available for grade crossing protection. More billions are to be made available for urban mass transit construction and expansion through federal funds matched at the local level. C&S and systems control budget, estimated to be $400 million for the Class I railroads in 1974, will be importantly, even dramatically, augmented in the years immediately ahead.

Retrenchment is not in sight. Rather, there will be a pressing demand for additions to C&S forces. There will be a shortage of skilled personnel, and a strong emphasis on training.

Those who supply the C&S departments of the railroads will have unprecedented demands for their equipment and services. Shortages, not orders will be their chief problems.

All signs indicate that the railway signalman will be the "most wanted" man of the year next year and for many years to come.

Robert G. Lewis, Publisher

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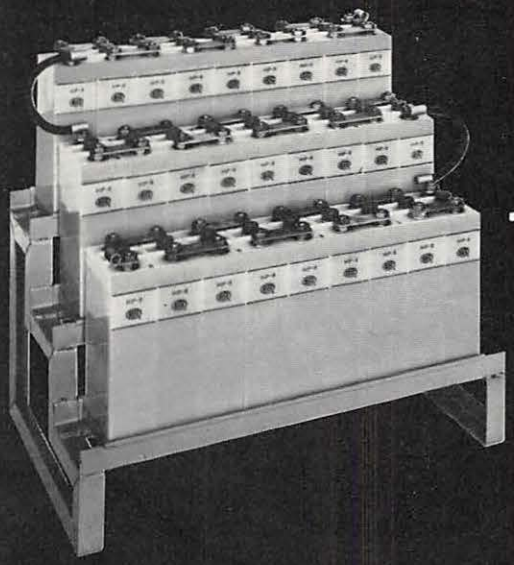

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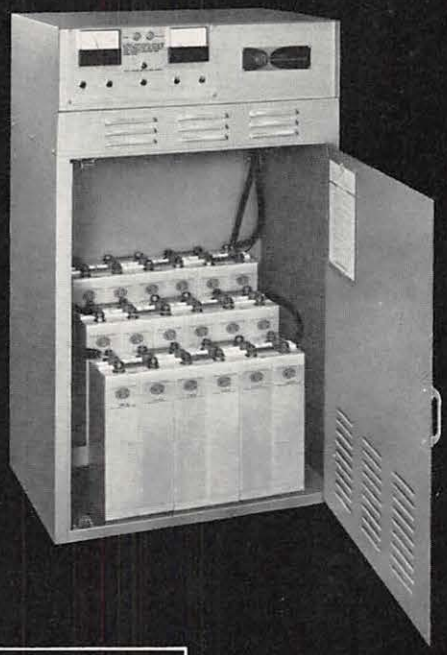

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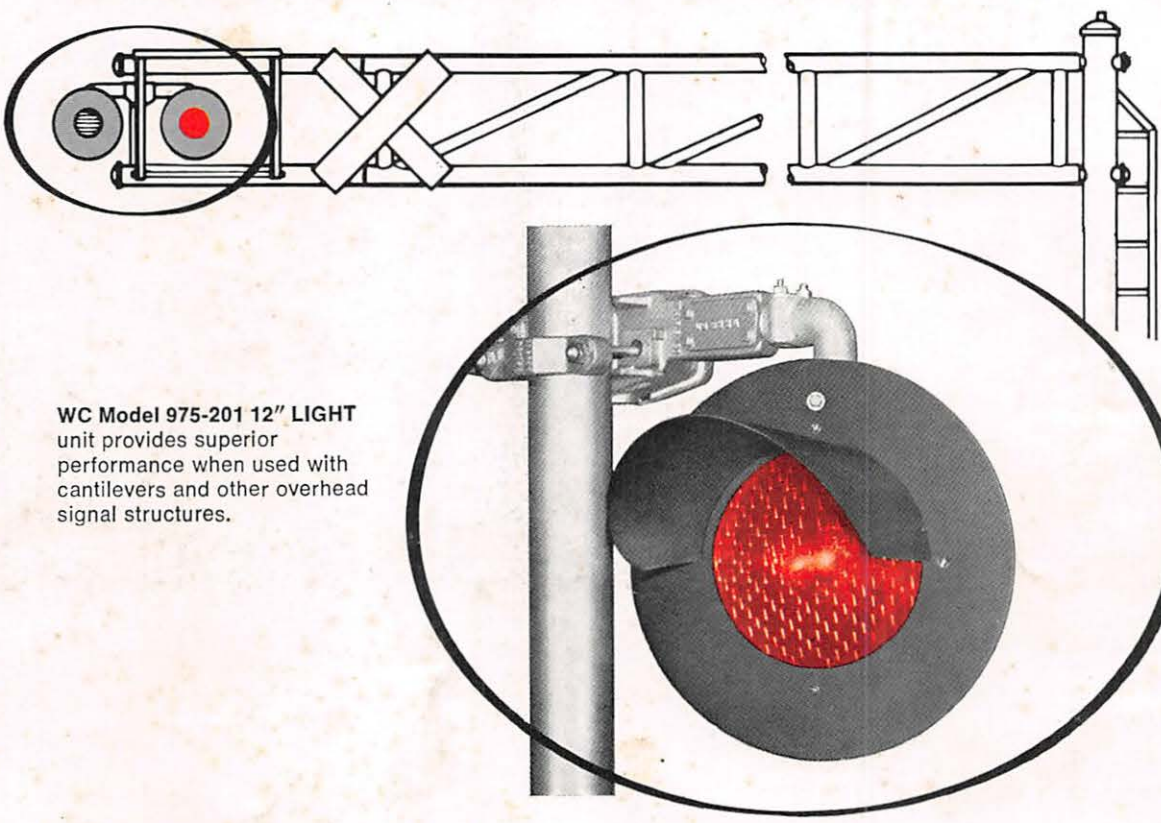

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